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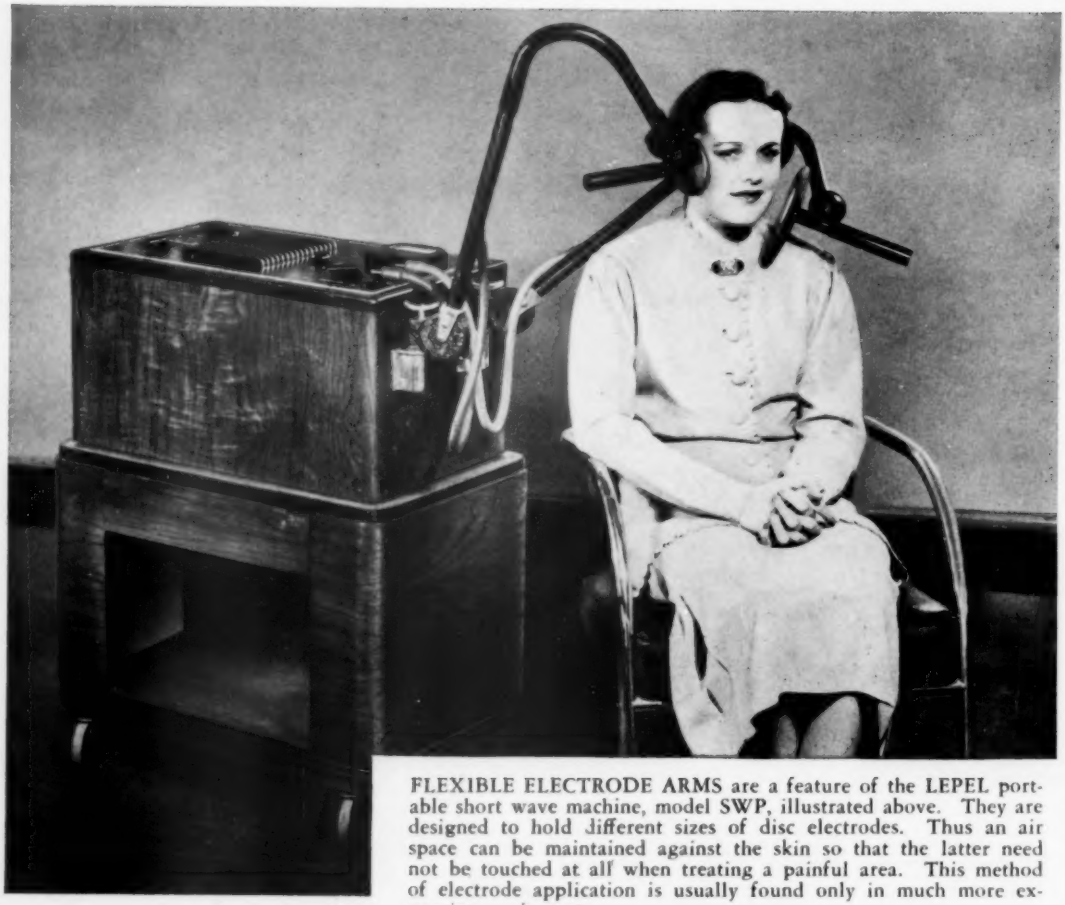

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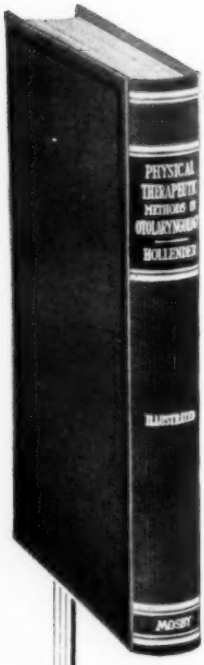

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SKIN REACTIONS. I. MECHANISM OF HISTAMINE IONTOPHORESIS FROM AQUEOUS MEDIA *

HAROLD A. ABRAMSON, M.D.

and

ARMINE ALLEY

NEW YORK

Although the introduction of histamine into the skin by a direct electric current is a therapeutic measure in widespread use, the mechanism of this process does not seem to have been adequately worked out.[1] The mechanism of histamine iontophoresis is of importance not only in relation to an understanding of skin physiology but also, practically, in connection with the introduction of other drugs. Procaine, for example, may be introduced by the galvanic current even though dissolved in an alkaline alcoholic solution.[2,3]

If histamine dihydrochloride is dissolved in an aqueous medium a dissociation of the dissolved salt takes place, liberating positively charged histamine ions:

$$\text{Hist.}(\text{HCl})_2 \rightleftarrows (\text{Hist.H})^{++} + 2\,\text{Cl}^- \qquad (1)$$

At the pH of a pure but fairly concentrated solution of this compound there will be practically none of the undissociated form, the base itself. However, as high dilutions are used, the pH of the solution will approach that of the diluent and more of the base may appear. Since histamine is comparatively a weak base, some of the base itself will form, dependent upon the pH according to the equilibrium:

$$\begin{array}{l} 2\,\text{Cl}^- + (\text{Hist.H})^{++} + \text{HOH} \rightleftarrows (\text{Hist.HOH})^{+} + \text{H}^+ + 2\,\text{Cl}^- \\ \qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad +\text{HOH} \\ \qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\quad \uparrow\downarrow \\ \qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad \text{Hist.}(\text{OH})_2 + 2\text{H}^+ + 2\,\text{Cl}^- \end{array} \qquad (2)$$

Iontophoresis[4] is here applied strictly to the movement of the ionized form given in equations (1) and (2).

So far as homogenous aqueous or other liquid systems are concerned the term ionization, if it is to be used at all for this purpose, should be restricted to the dissociation of a salt into its ions (molten salts are excluded). The electrical current does not do this; it demonstrates this dissociation. It is therefore, incorrect to use it in connection with the migration of charged particles like blood cells, bacteria, and the like, in an electric field, except to say that the particle itself acts as if it were an ion. The movement exhibited by a charged colloid in an electric field is designated as electrophorétic (or cataphoretic) mobility. This movement together with electroosmosis and related effects is classified under the heading of electrokinetic phenomena. When a metal electrode is applied to a tissue and the direction of the current is such that metallic ions are liberated, the metal may be ionized if the solvent is of high enough dielectric constant to have the salt formed dissociated. Whether or not ionization of the metal occurs, however, is not the therapeutic procedure. Iontophoresis should be the term when the therapeutic mechanism is believed to be due to independent ionic migration; electroosmosis should be the term of choice when the substance, e. g., alcohol, histamine base, procaine base, and the like is carried passively with the electroosmotic flow of liquid. The following classification is suggested:

* From the Medical Service of Dr. George Baehr, The Mount Sinai Hospital, New York City, and the Biological Laboratory, Cold Spring Harbor, Long Island, N. Y.

Ionization:
Ionization of gases
Ionization of electrolytes
($NaCl \rightleftarrows Na^+ + Cl^-$)

Electrokinetic Phenomena:
Electrophoresis or Cataphoresis
Electroosmosis
Streaming Potentials
Sedimentation Potentials

Electrophoretic Therapy:
Iontophoresis
Electroosmosis

Electrolysis:
To be reserved for procedures when actual decomposition of an electrolyte occurs.

Electroosmosis. — Since the pores and other apertures of the skin bear electric charges when their surfaces are in contact with aqueous media, if a direct electric field is applied, there will be an electroosmotic flow of liquid through the skin and tissues. This phenomenon was first observed by Kühne[5] in 1860, on muscle and was correctly applied by Rein[2] to the skin in 1924, in his study of electroosmotic anesthesia of the skin. It will be shown here that histamine wheals may be produced by the direct current in solutions as alkaline as that produced by M/20 NaOH. Reference to equation (2) will disclose that if the dissociation constants of the basic group are of the proper order of magnitude, little of the charged form may be present in solutions so alkaline. In this instance we shall speak of an electroosmosis of liquid with passive transfer into the skin of uncharged histamine base, if wheals form.

Methods

The effect of the electrical current was measured by the presence of a wheal, irrespective whether it was confluent or discontinuous. The current itself was provided by three "B" batteries in series, the total potential of which was applied to three 5,000 ohm potential dividers in parallel. The negative pole was made common but three positive poles were tapped from the potential dividers with each positive pole having a milliammeter in series. In this way the resistance could be controlled so that three areas of the skin could be studied simultaneously, keeping the current density constant. The anterior aspect of the forearm was the site most frequently employed. After using rather complicated devices to apply the cotton saturated with histamine solution to the skin, a simple electrode of heavy copper mesh bent at right angles, so that the area of the metallic electrode was about 1 cm.^{2}, was found most suitable. The cotton beneath was slightly larger so that wheals having areas of about 3 to 4 cm.^{2} were obtained with the highest concentrations of histamine. The cotton was carefully washed and dried. The electric field was always applied for five minutes.

The circuit of the apparatus is depicted in figure 1. Note that although three electrodes were employed here to run simultaneous, comparable experiments, any number may be employed using a similar circuit.

1. *Effect of Histamine Ions.* — It is very surprising to observe that with a technic not especially designed to detect small quantities, as high a dilution as 1:4,800,000 of histamine may be effective in an aqueous solution in the absence of added electrolytes[6*] (table 1). As mentioned above, with increasing dilution of histamine dihydrochloride solution the pH will approach

* Deutsch states that concentrations up to 1:1,000,000 had been previously detected.

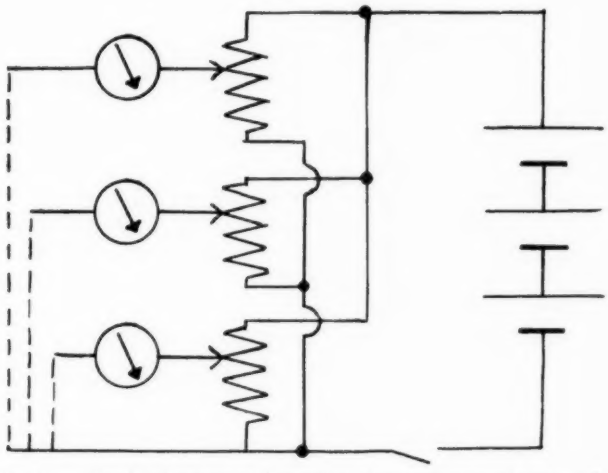

Fig. 1. — Circuit of apparatus illustrating simultaneous employment of three electrodes for study described in text.

TABLE 1. — *Experiment Illustrating Effect of Concentration of Histamine on Wheal Formation*

Concentration of Histamine	Approximate Current Density Milliampere	Results
1:5,000	0.3	Large wheal
1:25,000	0.3	Large wheal
1:300,000	0.3	Slight discontinuity in wheal
1:1,200,000	0.3	Flat and discontinuous wheal
1:4,800,000	0.3	Small separate flat wheals
1:5,000	0	No effect

that of the diluent. However, in the experiment given in table 1, the reaction is essentially due to the migration of the histamine ion itself and the equilibrium is depicted by equation (1). There is, of course, an electroosmosis of liquid through the skin. Since there is no precise information concerning the net charge of the skin* for the conditions under discussion there is no method of determining whether the effect is a decrease or an increase of the transfer of histamine through electroosmotic forces.

That the formation of wheals was due to the presence primarily of the charged form, was tested further by producing wheals by means of solutions of histamine dihydrochloride in dilute hydrochloric acid. Typical wheals were observed.

2. Effect of Added Salt on the Migration of Histamine Ions. — If both the current density and the concentrations of histamine dihydrochloride are kept constant, added salt, say KCl, will decrease the current carried by the histamine ions with the result that in a given period the other salt ions present will account for the flow of current. Assuming that the electric mobility of the histamine and potassium ions are approximately the same, the effect of the added salt will be proportional to the ratio of the concentrations of these ions. Table 2 is an experiment illustrating this effect. The concentration of the histamine was 1:5,000 or about M/900; the KCl

* Deutsch implies that histamine dihydrochloride may reverse the sign of the charge of the skin. If the isoelectric point of keratin be taken as that of the skin, this reversal of sign of charge may well be true in the presence of divalent histamine ions and sufficient acid. But if the electroosmotic flow occurs mainly through the pores and hair follicles, there is no precise information to guide us (except skin potentials measured by a diffusion method, not electrokinetic) in locating the isoelectric point. In basic solutions similar to those employed here there is little doubt that the net charge of the skin is negative.

TABLE 2. —*To Demonstrate Effect of KCl on Iontophoresis of Histamine Dihydrochloride*

Solution	Approximate Current Density Milliampere	Results
Histamine, 1:5,000	0.35	Large wheal
Histamine, 1:5,000 2.4 M.KCl	0.35	Small scattered flat wheals, negligible compared with above
Histamine, 1:5,000 2.4 M. KCl	0	None

was 2.4M. The histamine effect should be theoretically approximately as the ratio, $\frac{1/900}{2.4}$ or $\frac{1}{2160}$, of the effect with a 1:5,000 dilution. The data are in accord with this calculation. The addition of a simple salt is observed to decrease the effective concentration of histamine.

3. *The Passive Transfer of Histamine $(OH)_2$ Due to Electroosmosis in Alkaline Solution.* — The data in tables 3 and 3a illustrate that in solutions the pH of which is pH 12 or more, typical histamine wheals are readily obtained.

TABLE 3. — *Electroosmosis of Histamine in Very Dilute Solutions Containing M/1000 NaOH. Current Density Approximately 0.3 Milliampere for Five Minutes*

Concentration of Histamine	Results
1:5,000	Large wheal
1:20,000	Large wheal
1:100,000	Continuous wheals less elevated than above
1:1,000,000	Numerous small wheals
1:5,000,000	Small wheals less numerous than above
0:	No wheal

TABLE 3a. — *Electroosmosis of Histamine in Very Dilute Solutions Containing M/100 NaOH. Current Density Approximately 0.3 Milliampere for Five Minutes*

Concentration of Histamine	Results
1:5,000	Large wheal
1:20,000	Large wheal
1:100,000	Continuous wheals less elevated than above
1:1,000,000	Numerous small wheals
1:5,000,000	Small wheals less numerous than above
0:	No wheal

It is reasonable to suppose from the available material on the isoelectric points of proteins and tissues that the net charge of the skin is negative under these experimental conditions.[8] There will be, therefore, an electroosmotic flow away from the anode, for the tissue fluids would be positively charged relative to the skin. Since the second dissociation constant (half-neutralization point) of histamine is at pH 9.7 (M. Levy[9]), it follows from elementary consideration of the mass law that the ratio,

$$\frac{\text{charged histamine ions,}}{\text{uncharged histamine base}}$$

is of the order 1:1,000 in table 3 and 1:100 in table 3a. There is, therefore, an insufficient number of histamine ions in the highest dilutions to yield the histamine effects observed. Further, there is an additional effect of the added electrolyte which would also decrease the effective migration of histamine ions. This has been described in the preceding section. It must be concluded, therefore, that the formation of wheals by means of the gal-

vanic current in solutions as alkaline as these, is due to an electroosmotic flow of liquid which passively transports undissociated histamine. The electroosmosis depends on the ζ potential (electrokinetic potential) of the surfaces of the pores involved.[8] Since strong electrolytes depress this potential and consequently the electroosmotic flow, a greater effect is observed in a more dilute alkali. This is in accord with the usual depressant effects of strong electrolytes on electroosmosis described in the next section.*

4. *The Effect of Strong Electrolytes on the Electroosmosis of Histamine.* — If the histamine is in a solution alkaline enough to lead to the formation of the constituents given in the right hand side of the equilibrium depicted in equation (2) there results, practically speaking, only the undissociated form. Addition of a strong electrolyte like KCl or NaCl (tables 4 and 4a)

TABLE 4. — *Effect of Strong Electrolyte on the Electroosmosis of 1:20,000 Histamine in NaOH. Approximate Current Density 0.3 Milliampere for Five Minutes*

Concentration of Electrolyte	Results
0 KCl M/20 NaOH histamine	Large wheal
3M KCl M/20 NaOH histamine	No wheal
3M KCl M/100 NaOH histamine	Minute indistinct scattered wheals
3M KCl (no histamine)	No wheal
M/20 NaOH (no histamine)	No wheal

TABLE 4a. — *Effect of Varying Concentrations of KCl on Electroosmosis of Histamine. Current Density 0.3 Milliampere for Five Minutes*

Solution	Results
1:5,000 histamine in M/60 NaOH	
0 KCl	Large wheal
0.08M KCl	Large wheal
0.8M KCl	A few small discontinuous wheals
2.4M KCl	Very small scattered wheals

must produce an important effect on the electrokinetic potential of the skin itself. It is well known that salts depress the electroosmotic mobility. This is, indeed, predictable to a certain extent by the Debye theory of electrolytes. Tables 4 and 4a show that electroosmosis of undissociated histamine is decreased by simple salts. Under our experimental condition 3M KCl abolished wheal formation completely. This does not indicate, however, that no electroosmosis whatsoever took place. It signifies, rather, that insufficient histamine penetrated to produce a wheal. It is of importance that small scattered wheals occurred with concentrations of KCl even as high as 2.4M. This result is evidence contrary to the point of view of Amberson in regard to the importance of the electrokinetic potential of tissues in biological processes. This is discussed elsewhere by one of us.[10]

Discussion

It seems likely that with greater current densities and longer experimental periods higher dilutions of histamine may be detected. This method is so sensitive that it may serve as a semi-quantitative test for the presence

* According to Levai the passage of the electrical current itself may alter skin permeability so that the skin treated with the anode absorbs more histamine on subsequent application than that treated with the cathode. To test the possibility that an effect of this type may have been contributing to the results ascribed to the electroosmosis the following experiment was performed. Current was passed through the skin as usual. The circuit was then broken and a 1:1,000 solution of histamine dihydrochloride was applied to the treated skin for ten minutes without wheal formation. In a second experiment a 1:3,000 histamine (base) in M/100 NaOH was applied similarly without wheal formation. It is possible that with higher current densities and longer application of the solution the phenomenon described by Levai may be obtained. But this phenomenon apparently does not in any way account for the wheal formation ascribed by us to electroosmosis.

of histamine. Although in the absence of electrolytes wheals of about the same size were observed in histamine solutions diluted with distilled water and with dilute alkali, it is not certain from our experiments that the effect of the drug is independent of the pH. It would be of interest to study the effect of pH keeping the salt content constant. The influence of Ca^{++}, Ba^{++}, $SO_4^{=}$, and other ions commonly employed in ion antagonism experiments would also be of interest especially in view of the calculations of Moyer and Bull[11] who found antagonisms of this sort connected with the net surface charge of cellulose.

Experiments with histamine similar to those reported here in detail have been performed with aqueous mixtures of acetone and alcohol in the presence of alkali. Smaller wheals were obtained than with simple aqueous solutions. In these experiments even fewer histamine ions should have been present than in aqueous media. Since there are apparently no data on the dissociation constants of histamine under comparable conditions, these experiments may be considered only as presumptive evidence of the electroosmosis of histamine.

Further work on the possibility of introducing drugs electroosmotically with extension to non-aqueous media should provide new methods of electrotherapy as well as a further insight into skin permeability and its correlation with the net charge of the skin. An example of this type is the use of an alkaline alcoholic solution of cocaine to produce an analgesia before drilling teeth. Dr. Daniel Ziskin and one of us (H. A. A.) have found in fifteen trials that sufficient analgesia is produced with a solution of this sort to permit manipulation and drilling without pain depending upon the current density for a given time in all types of cavities thus far investigated. These data will be presented in a subsequent communication.

Summary

1. The relationship of iontophoresis and "ionization" of drugs through the skin is clarified and discussed in connection with electrokinetic phenomena.

2. A method is described which enables the simultaneous study of the same drug under comparable conditions in different media.

3. Iontophoresis of charged histamine ions may be readily detected by wheal formation in dilutions as high as 1:4,800,000. Salts abolish this effect.

4. Electroosmosis of undissociated histamine may also be detected in the same range of concentration. This passive transport of histamine may be diminished by strong electrolytes because of the lowering of the electrokinetic potential of the skin.

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HISTAMINE IONTOPHORESIS IN RHEUMATIC CONDITIONS AND DEFICIENCIES OF PERIPHERAL CIRCULATION *

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and

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The powerful effect of histamine and histamine-like substances on the capillaries and arterioles has been demonstrated by Lewis[1] and Starr.[2] A number of investigators have stressed abnormal or insufficient peripheral circulation as an etiologic factor in the production of rheumatic affections in muscles, nerves and joints. Both of these considerations have induced Deutsch[3] to apply histamine by iontophoresis to the affected structures. He introduced, in 1931, evidence of the efficiency of this treatment and was sustained by a number of investigators. Deutsch is, therefore, the originator of the method of the application of vasodilatating agents by iontophoresis.

The principles and technic of histamine iontophoresis were presented extensively in a series of lectures and papers since 1933 by Kling.[4,5,6] This paper is concerned with the more recent progress in the application of histamine.

Technic of Histamine Iontophoresis

For an effective technic one must make use of a reliable galvanic apparatus equipped with an accurate milliammeter. The histamine solution is introduced into the tissues by the positive electrode. A padded electrode or strips of block tin or lead foil covered with gauze of adequate size are employed. We find it most economical and hygienic to apply the histamine solution on filter paper to the affected parts over which the well moistened positive electrode is secured by bandages.

Formerly, we have used a 1-1000 histamine solution, but we have found a 1-2000 solution entirely sufficient for the treatment of smaller areas (electrodes of the size 4"x6"). With very large electrodes like those used in the treatment of sciatica, brachial neuritis and circular disturbance of the extremities, a solution of only 1-3000 was found sufficient.

We again stress the necessity of treating in myositis both the antagonist as well as the affected muscles. In the treatment of joints it is necessary to cover the whole circumference, while in the treatment of nerves their course should be covered. The treatment lasts from three to five minutes per application. The intensity of the current should not exceed one-half milliampere per square inch of smaller electrodes and only one-fourth milliampere per square inch of large electrodes.

The simultaneous treatment of a number of joints or muscles is achieved by branching cords connected with the positive pole. A pole changer permits the introduction of histamine to different parts without the necessity of re-checking polarity of electrodes. The short duration and the low intensity of current with the mechanical aids of serial connection and change of polarity, permit the speedy, convenient and safe treatment of a number of cases with multiple affections.

* Read at the Fifteenth Annual Session of the American Congress of Physical Therapy, New York City, September 8, 1936.
* From the White Memorial Hospital, Los Angeles.

The exposed skin reddens immediately after the removal of the positive electrode. Soon wheals crop up (fig. 1) and blend into one patch of urticaria (if cataphoresis was used). The temperature over the treated parts rises 2 to 3 degrees C. (3.6 to 5.4 degrees F.). The skin returns to its normal appearance in five to six hours.

Capillary microscopy shows a marked increase in the rate of circulation, in the number of capillaries visualized, and dilatation of the subpapillary vessels. Bettmann[7] observed this phenomenon after prolonged treatments to last for weeks.

In order to intensify the action in especially painful and acute conditions we have applied histamine iontophoresis several times daily. Such a technic is rarely possible in the office and hospital, for which reason a technic of home treatment was developed.

Any therapeutic measure for home use must be reasonably safe, simple and inexpensive. Histamine iontophoresis was found to fulfill these conditions. Apparatus are now available at a low price, or rental. The low intensity of current required for histamine iontophoresis makes its application safe. The technic can be carried out by an especially trained technician. Under proper supervision satisfactory results have thus been obtained in patients who otherwise could not have been efficiently treated.

In certain affections we have found that iontophoresis of histamine combined with other drugs yields better therapeutic results. In osteoarthritis, for example, a combination of a 1 per cent solution of sodium iodide applied from the negative pole, improved the action of histamine iontophoresis. In rheumatoid arthritis histamine was combined with a 1 per cent solution of quinine hydrochloride, while occasionally a combination with a 2 per cent sodium salicylate was used.

In neuralgia, especially trigeminal neuralgia, the combination of a highly diluted (1-30,000) solution of aconitine with histamine was found efficient by Brünner-Ornstein.[8] This author, and Ehrenwald[12] have described a special technic of iontophoresis through the cranium, which was very effective in angiospastic headache and migraine.

Evaluation of Substitutions and Modifications

1.—*Mecholyl.* For the purpose of comparative investigation of the effect of histamine and mecholyl on the peripheral circulation, we have used the simple classical tests of Lewis and Starr. A drop of 1 per cent mecholyl applied on the skin and introduced by needle pricks into the corium produces a wheal which is smaller, and a flare which is fainter than those with a 1/10 per cent solution of histamine. As the flare is an indication of the dilatation of the arterioles, it indicates that the action of 1 per cent mecholyl is not only weaker than the action of 1/10 per cent of histamine on the capillaries, but on the arterioles as well. (fig. 1.)

Introduced under a diseased part the reaction of 1 per cent mecholyl iontophoresis was decidedly inferior to 1/10 per cent of histamine. In the latter within five minutes, the wheals had formed a prominent patch of urticaria. The flare surrounding them was deep red. With mecholyl after fifteen minutes, with several times the amount of current necessary for the histamine reaction, the urticaria was less pronounced and the flare was smaller and pinkish. The temperature increase was markedly less than over the skin treated with histamine.

A number of patients were given without their knowledge alternate applications of histamine and mecholyl. The relief was declared to be far less after mecholyl than after the histamine application. Apart from the inferior effect of mecholyl on the circulation and symptoms, the higher concentration of cur-

rent (up to 30 milliamperes) and the longer duration of treatment are factors not to be ignored. The latter are responsible for the absorption into the general circulation and the production of systemic reactions like dizziness, palpitation, spasm of the smooth muscles which may provoke asthmatic attacks.

2.—*Parenteral Application of Histamine.* Shanson and Eastwood[9] have recommended subcutaneous injections. This modality produces systemic reactions while vaso-dilatation over the joints is moderate. Unless sufficient evidence is produced that the general reactions possess a therapeutic effect, we do not see any justification for the treatment by injection.

Clinical Results

This study is based on 259 patients with various affections of a neurogenic, vascular, arthritic and rheumatoid character, (table 1) showing the ratio of cure or improvement to failures as being three to one.

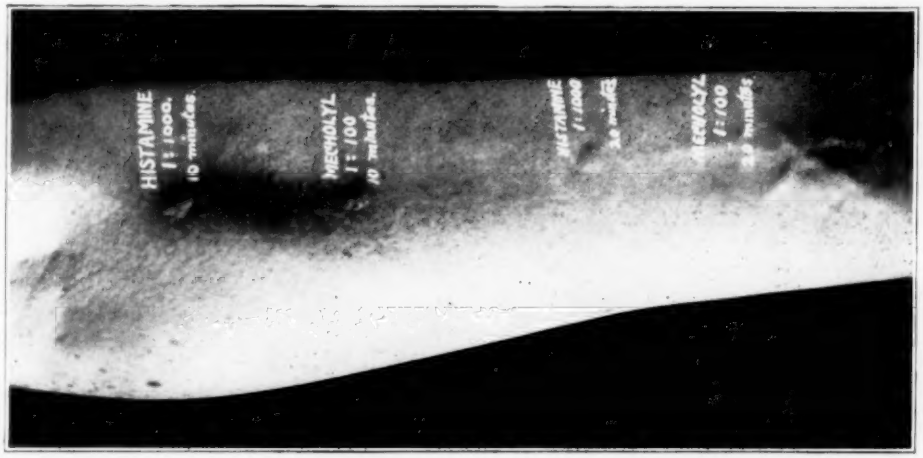

Fig. 1. — Comparison of the effect on the capillaries and arterioles of a 1:2000 solution of histamine and a 1:100 solution of mecholyl. The wheal and flare produced by mecholyl is about half of the size of the one produced by histamine. After 20 minutes the histamine reaction still pronounced, mecholyl has almost disappeared.

In the group of neurogenic and vascular diseases 13 cases in our table are vasospastic conditions and contain 6 cases of acroparesthesia with tingling and numbness in the fingers, four of which were decidedly benefited by histamine iontophoresis. Of 2 cases of Raynaud's disease in this group, one was benefited. One case of angioneurotic edema of the knee was cured after histamine iontophoresis. In the 2 cases of Buerger's disease, one was improved. Very remarkable success was achieved by the histamine application in 2 cases of painful induration of the skin after salvarsan injections, which were treated for months with other measures without success. One case, a woman aged twenty-four, developed flexion contracture of the right elbow at 120 degrees. Immediately after the first histamine application, there was an increase of thirty degrees in the range of motion and after 6 treatments there was a return to normal.

These results support the findings of other investigators of the good effect of histamine iontophoresis in disturbances of the peripheral circulation. Vas[10] reported in 1932, good results in 18 cases out of 20 of acroparesthesia, in 2 cases of Buerger's disease, a case of Raynaud's disease and in 3 cases of chronic ulcer of the leg.

The latter indication is useful in only a limited amount of cases because we have now at our disposal a number of efficient therapeutic measures which

TABLE 1.—*Results in 259 Cases of Histamine Iontophoresis*

Condition	No. of Cases	Cure or Imp.	%	Not Imp.	%
Vasospastic Conditions	9	7	78	2	22
Buerger's Disease	2	1	....	1	....
Skin Induration After Salvarsan Injection	2	2	....	....	....
Myositis	56	46	82	10	18
Subacromial Bursitis	15	15	100	....	....
Tenosynovitis	11	9	82	2	18
Brachial Neuralgia	11	10	91	1	9
Post-Traumatic Arthritis	10	9	90	1	10
Rheumatoid Arthritis	42	30	71	12	29
Gout	4	4	....	....	....
G. C. Arthritis	7	5	....	2	....
Osteoarthritis	51	33	65	18	35
Sacroiliac Arthritis	19	7	37	12	63
Spondylarthritis and Radiculitis	20	12	60	8	40
Total	259	190	73.3%	69	26.7%

are simpler and require fewer applications. We make use of elastic bandages and Unna's paste boot which can be worn for weeks. Another simple technic is the injection of novacaine saline solution into the indurated edges of chronic ulcers, as described by Tunick and Kling.[11] A modification of this technic consists of the injection of the patient's blood serum. Only when these means alone prove insufficient, combination with histamine iontophoresis of the leg is advised.

Rheumatic and Traumatic Affections of Soft Tissues

The group comprises myositis, subacromial bursitis, tenosynovitis and brachial neuralgia. The results in myositis are excellent. In acute cases it is the consensus of opinion, that over 90 per cent were cured with only a few treatments. The material in this group is large, and in 1933, Kling was able to tabulate from the literature 376 cases of which 343 or 91.2 per cent were cured or improved. Areas involved were muscles of the neck, shoulder, loin, thigh, calf and muscles of the feet. The treatment is just as effective in traumatic myositis after strain or sprain. In our present material (56 cases) the duration in 20 cases was over six months and yet the cure or improvement occurred in 16 cases or 82 per cent. A very valuable criterion of the efficiency of histamine iontophoresis in myositis is the degree of alleviation of pain and increase of motion immediately after the application. The treatment of subdeltoid bursitis by histamine iontophoresis and of tenosynovitis of the tendons and of brachial neuralgia has been so successful that we use it as the therapy of choice.

Of the various joint conditions, the best results were achieved in post-traumatic arthritis. Nine of the 10 cases treated were cured. In 4 cases of gout, a good effect on the pain, tenderness and inflammation of the joints was seen. In 7 cases of gonococcal arthritis, 5 were improved.

In rheumatoid arthritis, including cases classed as infectious arthritis, there was improvement in 30 out of 42 cases. This consisted chiefly of the decrease of pain and tenderness of the periarticular structures and subsequent increase in motion at the joints. No effect was noted on the articular effusions. This method is more effective in the treatment of smaller than the large joints. The treatment is often prolonged or should be combined with other measures.

The cases of osteoarthritis were chronic affections, chiefly of the knees, hips, finger joints in middle aged and old people. They were advanced and showed very pronounced spur formation and deformity of the articular surfaces. In about 15 per cent there were effusions of the joints. Treatment is prolonged.

Relief of pain, stiffness and some increase of motion was seen in 33 out of 57 cases.

We list sacroiliac arthritis as a special group because clinical or x-ray features usually do not permit a definite classification. Histamine iontophoresis in this group has appeared to be least efficient. Only 7 cases out of 19 have derived any benefit. In arthritis of the spine we have not subdivided the cases of rheumatoid origin and osteoarthritis, because the clinical and x-ray features of both groups were often met in the same patient. Out of 20 cases, 12 have derived definite relief of pain and spasm and increase of motion from histamine iontophoresis. Treatment here is also not only prolonged but to be combined with other measures.

Summary

Further progress in the application of histamine iontophoresis of disturbances of the peripheral circulation and rheumatic conditions is presented.

A solution of 1-2000 was found sufficient for the treatment of smaller areas while for larger areas, not more than a solution of 1-3000 is needed. The concentration of current per square inch should not exceed one-quarter to one-half of a milliampere. The duration of the treatment does not need to exceed five minutes. The low concentration of current and the short duration of the treatment together with the application of multiple electrodes, render the technic safe, devoid of dangerous system reactions, and permit the rapid and simultaneous treatment of several joints. The above factors render it possible to bring the benefit of histamine iontophoresis to the patient's home.

Mecholyl iontophoresis was found to be inferior in its action on the capillaries and arterioles. It needs more than ten times as high a concentration of the solution and several times as long a concentration of current and duration of treatment. It also has its drawback of alarming systemic reactions.

The effect of histamine iontophoresis in affections of soft tissues, bursae and tendons is superior to any other physical measure, yielding from 80 to 100 per cent improvement. In brachial neuritis, 90 per cent have been improved or cured.

In arthritis its effect varies according to the type and the stage of the affection. In post-traumatic arthritis it was invariably successful. In rheumatoid arthritis and in gout it brought relief of pain and a decrease of the periarticular swelling and an increase of motion especially in the smaller joints, in a large percentage of cases. The results in osteoarthritis of the peripheral joints, arthritis of the spine of mixed etiology the percentage of improvement was smaller. Very little effect was seen in sacroiliac arthritis.

It has given relief in over 60 per cent of the cases of peripheral circulation, such as Raynaud's disease, acroparesthesia, angioneurotic edema and Buerger's disease. It was found to be efficient in cases of chronic ulcers of the leg and perivascular infiltration after salvarsan injections.

The striking efficiency of histamine iontophoresis in rheumatic and traumatic affections of the soft tissues (muscles, tendons and nerves) renders it the method of choice.

In different types of arthritis it serves to relieve the pathologic involvement of the soft tissues and increase the peripheral circulation and is, therefore, a valuable addition to our therapy, especially as it lends itself to a combination with other therapeutic measures.

The credit for the introduction of iontophoresis of vasodilating agents belongs to Deutsch. Histamine iontophoresis was found by comparative study to be the most safe, efficient and economical of drugs.

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TREATMENT OF RHEUMATOID ARTHRITIS WITH MUD

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Rheumatoid (atrophic) arthritis is a systemic disease of unknown origin, characterized by a chronic course and progressive polyarthritis. Since rheumatoid arthritis is composed of both a constitutional and a local disturbance, its successful treatment requires adequate attention to both these factors. As a matter of fact experience teaches that rheumatoid arthritis cannot be relieved by treatment directed exclusively to affected joints. Although the general constitutional disturbance found in rheumatoid arthritis is not the result of the joint affection, it is far too common in medical practice to lay the main stress on the joints affected by the disease, and endeavor to bring about its cure by applying local measures, such as thermal procedures, to these joints. The natural result in such a systemic disease of mere local treatment is failure to produce an adequate effect.

Favorable therapeutic results obtained in rheumatoid arthritis from local application to the joints of mud packs seem to contradict the foregoing statement. But the exception is explained by the scientifically supported observation that mud packs, even when applied locally produce also a systemic effect. This general reaction is expressed as an alternative influence on the vital functions of the body. Alterations occur in body temperature, in the circulation, in the morphologic, serologic and chemical condition of the blood, and in the gaseous, cellular and mineral metabolism of the body.

In women it has been found that the action of the mud packs was

markedly enhanced by the simultaneous application of the mud to the affected joints and to the sacro-pelvic region.[1] Favorable results of this technic have been confirmed by other authors.[2] The improved therapeutic results of this combined treatment were attributed, in part, to a stimulating action on the endocrine glands, in particular the ovaries. Another possible explanation offered is a curative action on any morbid conditions that may be present in the pelvic organs and tissues, because such action would remove the deleterious effect of the conditions postulated for the activity of the ovaries. In some cases the healing of the morbid processes in the pelvis could mean the elimination of the actual cause of the joint disease.

Nevertheless the question persistently arises whether the favorable effect of the combined mud packs on the course of chronic arthritis in women is not to be explained by some other factor. This critical attitude seems to have justification in the fact that when mud packs are applied to the sacro-pelvic region in women with rheumatoid arthritis, it was never possible to limit the application exactly to the region in question, so that other abdominal organs shared in the treatment. Proceeding from that consideration and in the endeavor to influence the constitutional phase of the disease more intensively, mud was applied, in both men and women, simultaneously to the lower half of the trunk and the affected joints. The conclusions drawn were that this mode of treatment gave better results than treatment restricted to the affected joints or the combination of this with the sacro-pelvic mud packs in women.

Properties of Mud

For the treatment of rheumatoid arthritis by mud packs I make use of the natural mud of Pistany, which in most cases is combined with baths in the natural sulphur thermal waters. This natural mud, which is deposited in close connection with the sulphur thermal waters and to which no medicament is added, forms a gray-blue, almost black mass of buttery consistency, smelling of sulphur. Because of its physical properties this mud is very well suited for packs. These properties are a high degree of plasticity, low specific heat, poor heat conductivity and high specific gravity. The plasticity of the mud is due to its fine basic structure and considerable capacity for water retention and insures accurate application to any part of the body, leaving no air spaces between the skin and the mud. Since thermal tolerance of the skin to mud is greater than is the case with water, it is possible to make the applications at a high temperature. Owing to good retention, there is only a minimal loss of heat during the average 20 minute period of a pack. The pressure exerted by the mud on the skin results from its high specific gravity. The mud contains quartz particles, diatoms, coccoliths, neddles, and the like, thus supplying a mechanical stimulus. The mud also contains a certain quantity of radioactive substances, and so gives off emanation, which enters the lungs in respiration.*

Very little importance is usually attached to the chemical character of the mud, perhaps wrongfully. Because of the intimate connection between its origin and that of the thermal water, it contains substances in solution, by which the exertion of specific action is at least a possibility. Among the chemical substances contained in the mud, only the sulphur need be mentioned. This is maintained in continuous circulation by means of a thermophile bacterial flora of a peculiar kind (Korinek[3]), the result of which process is the formation of highly active sulphur compounds. Since sulphur is a lipoid-soluble substance, it can, if only in small quantities, permeate the

* The radioactivity of mud is so infinitesimal as to hardly produce any therapeutic results.

skin. Kilian[4] was able to demonstrate its resorption by applying mud to the shaved skin of a rabbit. Whether the sulphur which passes through the skin is to be regarded merely as a non-specific stimulus, or whether it may also have a specific action, remains unanswered.

Technic

Passing on to the technic of the mud packs, the author, in treating rheumatoid arthritis patients, has the mud applied both to the naked surface of the affected joints and also to the trunk, i. e. up as far as the costal arch on the left and the nipple on the right side, in front, and to the angle of the shoulder blade behind, and down as far as the uppermost part of the thigh, the layer applied being about 10 cm. (4 inches) in thickness. The procedure is as follows: On a couch is spread first a blanket, over that a linen sheet, then an oil-cloth sheet, and finally a piece of sheeting on which the mud is spread. The patient is placed in the mud and the body is then covered with a supplementary layer of mud in the manner already described. The parts of the body covered are then wrapped in the oil-cloth, the whole body in the sheet, and then the blanket is firmly rolled around the whole, so that only the head is left free.

The pack is usually followed immediately by a bath in the sulphur thermal water, and that again by a dry pack, i. e. the patient is wrapped in a sheet and a blanket. The final stage of the treatment consists of rest in bed for at least two hours.

The temperature of the mud is between 111 and 126 degrees F., that of the water between 100 and 104 degrees F. The duration of the separate stages of treatment (mud pack, thermal bath, dry pack) is prescribed according to individual circumstances, and varies on the average between 15 and 25 minutes. The whole course of treatment, with rest days interposed, requires on the average of four to six weeks.

The beneficial effects on rheumatoid arthritis cases of the mud packs given in the manner described may be attributed to various factors. Generally speaking, peloid packs produce local, focal and general reactions. The local reaction at the area of application of the pack appears as an intense reddening of the skin. The flushing is the result of hyperemia, produced by the thermal, chemical and mechanical stimuli and the pressure exerted by the mud on the surface of the body. The vascular dilatation is not confined to the skin surface, but extends to the deeper layers. By means of the improved circulation the heat is conveyed to the deep tissues, thus producing a rise in body temperature which gradually returns to normal after the treatment. With the simultaneous activation of the lymph circulation, the hyperemia and the accelerated circulation favor the resorption of the products of the morbid process. Relief of pain and stimulation of local tissue metabolism and of the activity of the skin glands are additional results of the mud application.

Increased pain in the foci of the disease is a sign of focal reaction. This occurs in the first 24 hours after the pack, and in the majority of instances ends within 24 hours. When combined packs are given, the focal reaction appears more frequently and lasts longer. I endeavor to avoid reactions during the course of treatment by suitable dosage of the temperature and the duration of the bath procedures, experience having taught that better results are obtained in that manner.

Systemic Reactions

With regard to the general reaction brought about by the mud pack it is comparable to a large extent with the action, characterized by the diverse

alterations of a cellular and humoral character, produced by the parenteral administration of protein substances. With the raising of the body temperature there is stimulation of the general circulation, lowering of blood pressure, raising of metabolism, intensive action on the functions of the skin and on the capillary circulation. This general reaction is characterized by an evident influence on the endocrine glands through the intermediary of the skin and the vegetative nervous system. Indeed there takes place an extensive influence on the whole vegetative life, including alterations in the electrolyte balance and the acid-base equilibrium, together with variable alterations in blood sedimentation, and the morphologic, chemical and serologic condition of the blood.

Treatment by mud packs may therefore be regarded as a kind of protein shock therapy, tending to increase the defensive reaction of the body against infection. The action of mud treatment on the general systemic phase of rheumatoid arthritis is thus by way of a general reaction, with its active intervention in the biologic functions of the human organism. This action obtains a special character through the inclusion of the trunk in the mud treatment, demonstrated by research still in progress concerning the behavior of the vital functions of the organism.

The constitutional phase of rheumatoid arthritis is also influenced by the action of the pack to the trunk on the abdominal and pelvic organs. The hyperemia extending to the deeper layers and the warming of the contents of the abdominal and pelvic cavities, lead to an increased supply of blood to the organs and better nutrition of the cells, with a consequent stimulation of organic function. These conditions culminate in increased resistance to disease and enhanced capacity of the organism to recover from it. Mention may be made here of the experiments by Gesenius,[5] who traced out the thermal action of the various therapeutic methods on laboratory animals by means of laparoscopy. His conclusions were that the older methods of applying heat, such as cataplasms, whole baths and peloids, were superior to the modern electrical methods (long and short wave diathermy) and infra-red treatment.

It is not possible to give any more detailed account of the stimulation of organic function, because of our scanty knowledge of the activities of the abdominal organs. Certainly, a fair amount is known about the functions of the liver, e.g. that in cooperation with other organs, it transforms proteins, carbohydrates and fats into a condition in which they can be made use of by the body tissues; and that it plays an important part in relation to detoxication, to the maintenance of the composition of the blood, to anaphylaxis and to the treatment of pernicious anemia. But information as to the spleen is very scanty. While Mark[6] looks upon it as an endocrine gland, Anton Fischer,[7] who used extracts obtained from normal organs, was unable to produce any action on blood calcium, serum phosphorus, serum cholesterol or blood sugar, or on anaphylactic eosinophilia. In fact, it was impossible to produce any evidence of the presence of any specifically active principle in the spleen. Only its role as a blood reservoir and as a constituent of the reticulo-endothelial system is actually known. In the present connection it is important to remember that the blood stagnating in the spleen, apart from the general circulation, is mobilized by means of the mud packs and restored to circulation, thus increasing the total circulating quantity of the blood. Stimulation of the ovaries for enhanced function has already been mentioned above.

Since in patients with rhemuatoid arthritis chronic inflammatory conditions of the abdominal or pelvic organs may be present, one cannot dis-

miss the hypothesis that the clinical improvement following combined mud packs may sometimes be due to their alleviation or cure. In some of the cases in question the prejudicial influence of infective foci or chronic inflammatory conditions on organic function will have been removed, in others the actual cause of the disease itself.

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CORRECTIVE TECHNIC IN COLON THERAPY *

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The following technic of a corrective method of the treatment of certain affections of the colon is presented from a clinical point of view, and essentially is a refinement of older principles aimed at re-establishing physiologic conditions at a minimum of trauma to the mucous membrane.

For this form of therapy we have made use for a long time of the Dierker apparatus, because it is constructed on a basis assuring the administration of colonic lavage within physiologic limits. It is equipped with a mercury manometer which in connection with other mechanical facilities not only enables resort to negative and positive pressure, but records existing anomalies, so that the apparatus is a diagnostic as well as a therapeutic aid. Thus by observing the manometer one can easily determine while the patient is under treatment whether the colon is tonic, hypertonic or atonic. Such recognition serves as a guide with particular reference of dosage. Thus when tonicity of the bowel is determined one has reached a degree when the treatment must be stopped to prevent overstimulation or fatigue of the intestinal musculature. The manometer does not vary in principle from that utilized for the taking of blood pressure and is as important an appliance in colon therapy.

In the presence of intestinal stasis or sluggish motility of the colon the use of the apparatus produces superior effects as compared with those of repeated "washings" for the purpose of unloading an overdistended and overloaded bowel. The superior effects are explainable by the function of the apparatus which stimulates the gut through the simple expedient of hydro-

* Read at the Fifteenth Annual Session of the American Congress of Physical Therapy, New York City, September 9, 1936.

static massage. In the type of cases requiring this kind of treatment one often sees restoration of bowel tonicity, which is an indication to stop the treatment and to advise the patient to empty the colon in a natural manner. This is almost always followed by a sense of well-being as contrasted with the sense of fatigue following the usual repeated washings.

Mechanical Action

Experience has shown that the dehydrating action of intestinal atony leads to an increase of the degree of sluggishness of motility with the resultant accumulation of waste material, presenting a veritable picture of a vicious circle. Is there any doubt that massage and exercise are helpful in the management of atrophy of skeletal muscles? If, then, such a management of muscular atrophy is useful in general types of asthenia, the same physiologic principles should theoretically have equally beneficial effects also in atony of the intestinal musculature, and especially of the colon. For many years external massage has been practiced for certain types of constipation, even though the intervening abdominal muscles and fascia must necessarily serve as a barrier against a direct effect on the colon. The very technic of beginning the manipulations at the lower region of the cecum and continuing them along the course of the colon toward the sigmoid flexure can have but one purpose. Negative and positive pressure under proper control of the Dierker apparatus must therefore be regarded as far superior to even the most skillfully performed external manipulations, because the toning effects are applied directly, that is within the lumen of the colon.

We know that the colon is distended by an ingested bolus, and the apparatus is so constructed as to substitute for the bolus a measurable quantity of fluid at any desired degree of warmth, as pure tap water or, if needed, as fluid medication. This, of course, can be attained to a certain degree also with any type of irrigator, such as is in popular use for the administration of enemas, but the apparatus does not depend on the action of gravity and quantity of a column of water, but is equipped to enable the production of very mild contractions of the colon by negative pressure. While often this method suffices to stimulate peristalsis, more often it will prove necessary to so manipulate the apparatus as to produce alternations of negative with positive pressure, a procedure of exercise which can be carried out within physiologic limits, as already alluded to. The technic proper is by no means complicated, the principal need being for observing the records of the manometer, which is a true gauge of the pressure within the lumen of the colon.

The value of properly controlled negative pressure, with and without alternations of positive pressure exerted within the colon has been established both clinically and experimentally. It is not our purpose here to recite very many favorable results obtained in actual practice, since these may be questioned as purely subjective observations. What we do emphasize is that we have resorted to all available measures for exactness in observation, such as sigmoidoscopy, x-ray investigations and other laboratory methods, both bacteriologic and chemical.

As a result of these observations we have found that if a quantity of fluid is retained in the rectum against the urge to expel the contents, the gradient changes toward the cecum. A small amount of a barium mixture injected and retained can be seen under the fluoroscopic screen to enter the cecum. Accordingly, the concept that to reach the entire colon one has to resort to large amounts of fluid is proved erroneous. The same holds good with regard to the degree of pressure required for effective lavage of the colon. The ordinary enema bag or irrigating vessel hung four and a half feet above the level of the patient produces a pressure of about two pounds, more than two times the force necessary to cleanse the bowel. It is established with mathematical precision that pressure is increased at the

rate of one pound for every 27 inches of elevation of the container, which is approximately one-half pound per foot of elevation. With the Dierker apparatus the required vacuum is induced with a negative pressure of one to two inches of mercury. One inch raises a column of water of 27 inches. So much for the hydrostatic effect of the apparatus.

Clinical Action

Clinically in selected cases of chronic stasis good results have been obtained by a series of brief stimulative treatments, normal defecation having been achieved virtually in all cases not due to grave organic lesions. We speak of this procedure as "corrective" in contradistinction to the usual cleansing applications. No attempt has been made thoroughly to wash away the contents of the colon, it having been shown that it suffices to exercise the bowel for a brief period and then to allow the patient to empty the bowel spontaneously. Such a corrective seance need not exceed 15 to 20 minutes, and the average number of treatments is about fifteen, six often having proved sufficient, a series of twenty applications seldom having become necessary. Occasionally aggravated cases may require one or two stimulative treatments per month after a series has been completed. These infrequent reapplications should be suggested in even milder types of chronic stasis to watch progress.

A means for a scientific record of treatments is available with the apparatus. Apart from the records of the manometer readings, the charts are diagrammatic, the abdomen being outlined regionally, so that the technician can note places which manifest especial tenderness at certain degrees of pressure, which are called to the attention of the attending physician, who regulates the treatment accordingly. In addition during each treatment note is made of the amount of gas, the color of the feces, the presence and amount of mucus, if any, its character (flaky, stringy, and the like), the observation being made in a connecting glass tube of the apparatus. Ordinarily the apparatus properly utilized produces no reflex symptoms, but experience has shown that when with mild applications patients complain of nausea, one should consider the presence of an incompetent ileocecal valve.

As was already intimated, there is no need of throwing into the bowel a quantity of fluid calculated to fill the lumen. The technician should be instructed to inject fluid only until it meets with resistance, irrespective of the quantity used up. Resistance may be due to fecal impaction, to spasm, or to organic stricture of the bowel. With the pressure registered by the manometer, the apparatus is set "at retention," which holds the fluid in the bowel. If now the mercury rapidly recedes towards the zero mark, it ordinarily indicates that one has to deal with a spasm which is abating. Slow recession of the mercury usually indicates the presence of scybala or gas bubbles, either of which can be determined in the return flow following subsequent injections. In organic stricture the return flow will show neither gas bubbles nor fecal particles or masses.

Recession of the mercury toward zero requires reinjection until the manometer registers static pressure. Tonicity or stimulation obtained by treatment is registered by a rise of pressure over the patient's comfortable tolerance. The retention should then be released and the patient instructed to expel in a natural way. When this natural act has been accomplished, our technic calls for the reinduction of negative pressure to contract the bowel.

About two to three gallons of water usually suffice for a complete stimulative treatment, part of the fluid being at first injected under pressure to cause distention of the bowel. Plain water is preferred as the vehicle, because apart from its physical quality of causing equal pressure at equal levels in all directions, it also aids in overcoming dehydration, while any desired

medication can be dissolved in it for whatever indications may be present.

Though we have been unable satisfactorily to determine whether or not the entire colon can be contracted by negative pressure, we have clinically reached the conclusion that such is the case. Thus we have often succeeded in removing barium clumps with the apparatus after repeated enemas have proved futile for this purpose.

Conclusions

Proper negative pressure alternated with positive pressure within the colon is a valuable therapeutic procedure, adjunct to classic management of many affections of the large intestine.

The Dierker apparatus is a scientifically constructed instrument for the internal stimulation of the musculature of the colon within physiologic limits.

The apparatus facilitates in differentiating functional disturbances, and thereby often serves as a guide to the proper method of intracolonic stimulation of peristalsis with resulting restoration of normal fecal evacuation.

ROENTGEN STUDY OF COLON *

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This study comprises all the cases admitted into the Newark Beth Israel Hospital from the years 1928 to 1936, inclusive. In these eight years, 310 patients were admitted into the medical and surgical wards for some disease of the colon. Of these cases, 235 either had x-ray examination and were treated medically, or else were operated upon with no previous x-ray study. The remaining 75 cases were treated surgically after x-ray examination. Autopsies were obtained where possible.

The colons were examined with dye either by mouth after twenty-four hours or else by barium-colon enema. In some cases, both methods were used. The roentgen physiology of the colon was better determined by the barium meal, while anatomic variations and morphologic characteristics were better determined by the barium-colon enema.

Normally, twenty-four hours after barium by mouth is given, the ascending, transverse and descending colon is filled. The normal segmented haustral markings are clearly outlined and evenly placed. Any spasm, bowel movements or atonic variations would alter these segmentations in size, shape and uniformity.

Embryologic Basis of Study

To recognize morphologic variations the embryology of the colon must be understood. It is important to know that very early in embryologic development the stomach and intestines are high in the hypogastrium. Even before the loops return to the abdominal cavity, the large intestine increases in diameter more rapidly than the small intestine. Peculiarly enough a

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severe attack of amebic colitis heals without leaving any roentgen sequelae, as distortion, dilatation, polyposis. White ulcerative colitis leaves in its wake considerable roentgen evidence of polyposis, distorted contour of the colon with an irregular lumen and spasm. The x-ray appearance of chronic ulcerative colitis depends upon three main factors: The duration of the disease, the virulence of the organism and the damage done to the colon. As the injury progresses in the colon, the various layers become more and more infiltrated resulting in the loss of normal haustral markings. The lumen of the colon becomes smaller, more rigid and the colon proper comes to resemble a pipe, called the "lead-pipe" colon.

It is essential to know that the contents of the colon increase in consistency as they proceed from the cecum to the rectum. More absorption takes place in the proximal than the transverse or descending colon. The fluid and salt absorptive powers in the cecum and ascending colon together with bacterial digestion must not be impaired. Any alteration must of necessity result in spasm and fermentation.

When the food arrives in the cecum four and one-half hours after leaving the stomach, it contains 90 per cent of water together with a small amount of unabsorbed products of digestion of proteins, fats and carbohydrates. Since most of the absorption occurs in the cecum and part of the ascending colon, we can readily see why colitis involving the proximal part is more severe than one involving the distal portion.

It was observed in our cases of ulcerative colitis as well as malignancies that when the lesions in the colon were in the proximal portions where absorption was greatest, the toxemia was more severe, while involvement of the distal colon and sigmoid caused less severe toxic reactions. Our only conclusions in this regard were the ready absorption of toxic substances.

Regional Peristalsis

The site of the disease in the colon has a marked influence on the symptoms. Diarrhea which is present in nearly all cases of ulcerative colitis is caused by irritation from the inflammatory process. When the lesion is located in the proximal colon, spasms appear in this region. Absorption being interfered with vigorous peristaltic waves are set up, resulting in diarrhea. In these cases mucilaginous demulcents that have properties of taking up watery fecal material would be indicated. On the other hand if the proximal two-thirds of the color is not involved, this peristaltic rush may not be present. If the process is confined to the rectum and lower sigmoid, a great amount of spasm might be set up in these regions, resulting in constipation.

With the history of constipation and the roentgen evidence of a dilated and apparently atonic colon, usually the diagnosis of "atonic constipation" is made. The physician upon receiving this report from the roentgenologist would proceed to treat his patient with food containing roughage, enemas, laxatives and high colonic irrigations. The physician is soon surprised to learn that his patient is now suffering untold agony in the lower abdomen together with mucous and some blood in his stools.

The constipation has now changed to diarrhea and the toxic symptoms have increased to some degree. A barium enema taken at this time would probably show some atony, but the preponderant roentgen picture would be irritability and spasm. We thus have a roentgen complex of atony alternating with spasm so often seen in conditions of ulcerative colitis.

It seems that the incoordination of the muscular motor function rather than its absence or paralysis is the basis of constipation. Under these con-

ditions it would be folly to try to functionally diagnose a transitional incoordinated colon by fluoroscopy and classify it as an "atonic" or "spastic" form of constipation. Thus the old terminology of "atonic" and "spastic" constipation is gradually being replaced by more exact clinical entities insofar as there are regions of relaxation in the colon as well as spasm.

In the study of our cases we have found that the colon may be functionally at fault where "redundancies" and "megacolon" exist, or else there may be an unbalanced autonomic innervation as seen in the spastic, irritable or atonic colon. Avitaminosis may result in muscle and nerve incoordination very much similar to cases having severe colitis.

All the cases under discussion have had a thorough work up, including a careful history, complete physical examination, endoscopic examination of both rectum and sigmoid where indicated, and a complete examination of the stool for blood, pus and parasites. The roentgen studies were repeated as often as necessary.

We have observed that many functional disorders existed in the colon in the presence of disease elsewhere in the body such as hyperthyroidism, cholelithiasis, ulcers, pulmonary tuberculosis, cancer, and others. Many histories of our cases revealed long use of enemas, repeated catharsis, and indiscretions in diet.

We have noted that when constipation suddenly comes on later in life in a previously normal person, the roentgen findings in a majority of cases were malignancy causing obstruction, diverticulitis causing spasm, irritability, chronic appendicitis, or tumors of the uterus in the female. In children, on the other hand, megacolon was found in the majority of instances. In these cases, lumbar sympathectomy was performed with good results in three out of four cases.

Summary

In closing, we should recognize chronic bowel disorders wherein on the one hand we have organic inflammatory lesions with involvement of the mucous membrane and on the other hand, disturbances related to the form and function of the bowel. These disturbances are characterized by diarrhea, constipation and blood in the stool altering not only the roentgen physiology of the colon but also its form and motor function.

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MANAGEMENT OF CHRONIC ARTHRITIS OF THE KNEE BY INTERMITTENT TRACTION AND A LEATHER-STRIP BRACE

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Chronic productive arthritis of the knee joint is a disease most commonly encountered in middle life in both sexes; in the female frequently at the menopause, and in the male at the beginning of the fifth decade and later, depending upon the patient's constitution and occupation.

For practical purposes, one might divide this type of condition into three main groups:

1. Patients in whom the arthrosis of the knee sooner or later follows an injury or disease of this joint which has caused some damage, interfering with the structures, or with the mechanism of this largest weight-bearing joint. In this group are included individuals in whom injury has led to disturbance of the normal weight-bearing alignment.

2. Individuals whose normal function of the knee is interfered with by the ageing of the joint structures, primarily the cartilage. The chief type of this group represents an arthrosis attributable to a disturbance of the internal secretions, as in the menopause.

3. Conditions characterized by a disproportion between the efficiency of the joint and the demands made upon it. In this group we include over-weight-bearing due to increase in body weight, or to an occupation which puts too much strain on the knee joint; lack of muscle power caused by various diseases; or abnormal weight-bearing through a shift of the weight-bearing line of the leg from a normal to an abnormal position.

Diagnosis

The diagnosis of a beginning arthrosis of the knee should be considered when a middle-aged patient complains of chronic pain in one or both knee joints. He frequently gives a history of this pain being relieved by rest and increasing with the time of weight-bearing. The pain is worse when going downstairs or downhill, worse on standing than on walking; the first movements when getting up from the sitting position being the most painful, but the knee becoming limber after a few steps. At the same time, examination shows no local heat, little or no tenderness on pressure, and sometimes only a very slight limitation of motion.

Osteo-arthritic changes in the joint may be assumed when we find that on moving the joint with the muscles relaxed there is crepitation of the joint surfaces. Roentgen examination of the knee joint with the usual antero-posterior and lateral views may reveal the typical picture of a productive osteo-arthritis; it may, however, be at first negative.

The degree of changes found in the x-ray picture of the knee joint is not proportionate to the loss of function and the amount of pain. One is frequently surprised to see that a knee with marked osteo-arthritic changes in the radiogram has a complete range of motion and has never caused any pain. On the other hand an apparently normal radiogram does not exclude disability by a painful knee joint. Nevertheless, roentgenologic examination of the knee joint is of great importance for diagnosis, prognosis, and therapy, and it must be our aim to secure more information from the roentgenogram

than we are able to obtain by the routine antero-posterior and lateral views.

An important step forward in this direction has been made by exposure with the joint flexed at 125 degrees, and the center beam directed into the knee joint parallel to the articular surface of the tibia. This exposure, which I have called the "tunnel" view, has proved valuable for the early recognition of minor changes in the knee joint, and especially for differentiation from a neuropathic joint or other processes. In order to standardize this special technic which might be adopted with advantage as a routine procedure, we have adopted the following technic.

Special X-Ray Technic

A very simple wooden appliance has been designed, the so-called "knee bridge" (fig. 1). The patient lies on his back with the leg resting on the

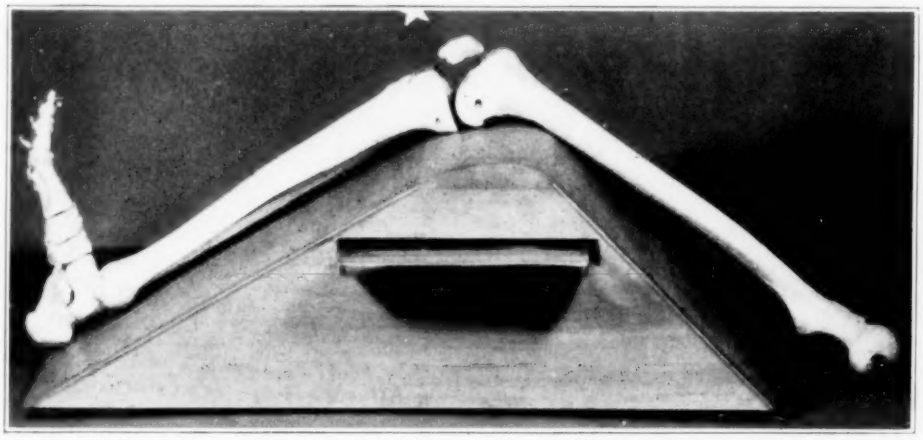

Fig. 1. — Knee bridge position for x-ray tunnel view.

knee bridge and the knee flexed to 125 degrees. The patella points upward exactly in the midline of the knee bridge in the same sagittal plane with the foot. A 6½x8½ casette fits into a slot as close to the knee as possible. The film-focus distance is exactly the same as is used for the lateral and antero-posterior views of the knee joint (in our department, 60 cm.). The exposure time is the same. The tube is tilted 25 degrees, the center beam running coincident with the articular surface of the tibia. This arrangement gives a clear view of the articular space in the knee joint, showing all the details of the intercondyloid fossa of the femur (fig. 2). The structures off center are, of course, distorted and must not to be studied from this exposure. We have used this technic for more than five years in practically every case where a roentgenologic examination of a knee joint was indicated.

Similar procedures have been recommended by others in recent publications. Henri Béclère[1] has used arched films for foreign bodies of the knee for fifteen years; Gerhard Danelius and Leo Frederick Miller[2] employed a similar technic. Some of the authors use a curved casette in the popliteal space, others a plain x-ray film wrapped in black paper and rested on a sandbag or roll. Their pictures are similar to or identical with those obtained by our method. We believe, however, that the simple and inexpensive equipment of our wooden "knee bridge" is preferable, because it facilitates the standardization of x-ray technic and does not require a curved casette.

The routine antero-posterior radiogram of the knee shows the joint space to be narrow, the contour of the tibial and femoral condyles in the normal

Fig. 2. — Osteo-arthritis, both knees. For description see text.

joint being almost parallel. No details of the intercondyloid fossa with the insertion of the crucial ligaments are visualized. Structures of calcium density within the normal joint, loose bodies for example, are as a rule projected into the picture of the condyles. The "tunnel" method, on the other hand, gives a wide view of such parts of the internal structures of the knee joint as are not visible otherwise. With this technic we have frequently found pathologic changes in knee joints which had been diagnosed as roentgenologically normal. We have found that osteo-arthritic changes may first be seen at the site of the insertion of the crucial ligaments at the internal aspect of the femoral condyles, and in several instances we have been able to make an early diagnosis of a Charcot joint by the recognition of pathologic changes in this area. A few examples may illustrate the advantage of the

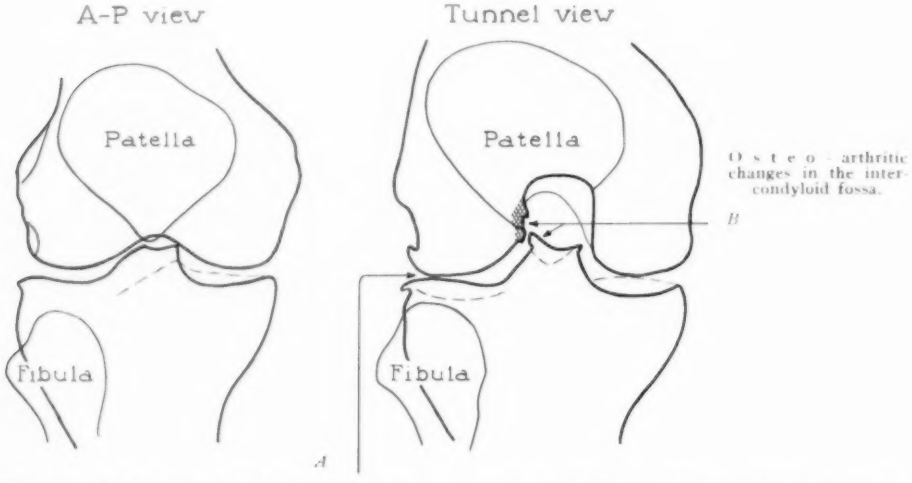

Fig. 3. — Arthrosis of right knee following injury to external semilunar cartilage, showing *A* marked narrowing due to degeneration of external semilunar cartilage, and *B* osteo-arthritic changes in the intercondyloid fossa.

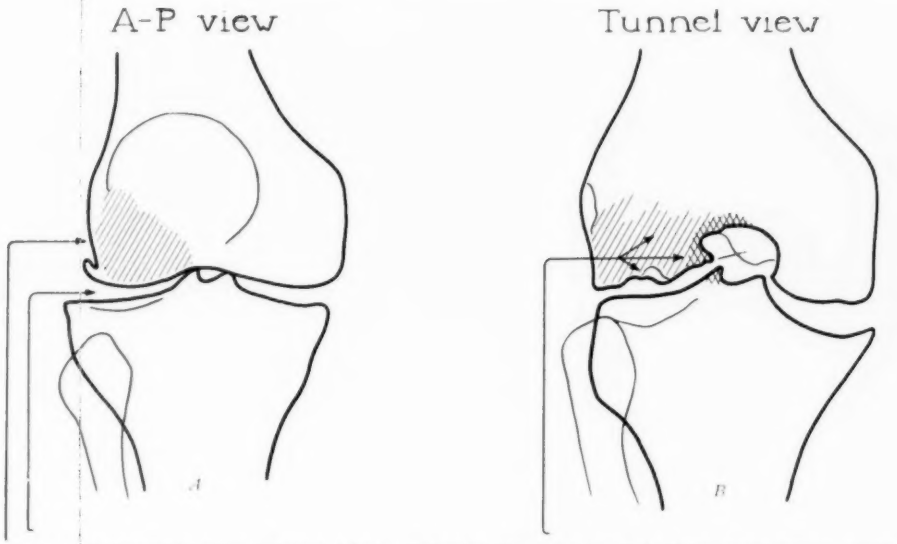

Fig. 4. — Arthropathia tabica (Charcot joint). Following the arrow in *A* the joint space appears normal and shows increased density of external femoral condyle. Following the arrow in *B*, there is noted a large defect and productive changes.

tunnel view in comparison with the commonly used antero-posterior examination made with the knee extended (figs. 3 and 4).

For the differential diagnosis of a chronic painful knee, it is emphasized that the joint is not infrequently the site of referred pain, when the lesion actually is in the hip joint or the foot. It is a common experience that children complain of pain in one or both knee joints, sometimes only at night, when they awake crying, when it is due entirely to wrong static conditions, mostly caused by pronated weak feet. The pain disappears after proper correction of the foot deformity or of the wrong weight-bearing. In some instances pain in the knee joint may be the first symptom of tuberculosis of the hip or Perthes' disease.

Faulty static conditions which have not yet affected the knee joint proper may come to our attention through the patient complaining of pain in the knee. This is frequently seen in women at the beginning menopause, without any evidence of pathologic changes of the articular surfaces. Increased body weight, relaxed ligaments, painful subcutaneous fat, and insufficiency of the muscles which endeavor to maintain proper weight-bearing alignment of the extremity may lead to a painful condition of the soft structures, especially the muscles in the region above the knee. On examination we find marked tenderness on pressure, not within, but in the adductor muscles just above the knee. This symptom is typical and frequently appears long before an arthrosis develops. In such cases there is no pain and no crepitation on moving the knee joint.

This observation leads to a discussion of the importance of correct weight-bearing. In the normal lower extremity the plumb line representing gravity runs from the center of the hip through the center of the knee and ankle joints, and comes to the ground at the center of the heel (fig. 5). If one of the structures at any level falls outside of this weight-bearing line, all of the joints of the extremity are affected. For instance, in apes valgus, or pronated foot, the weight-bearing line runs medially to the weight-bearing surface of the heel, thereby putting abnormal strain on the internal lateral structures of the ankle joint, the internal lateral ligament, and the internal

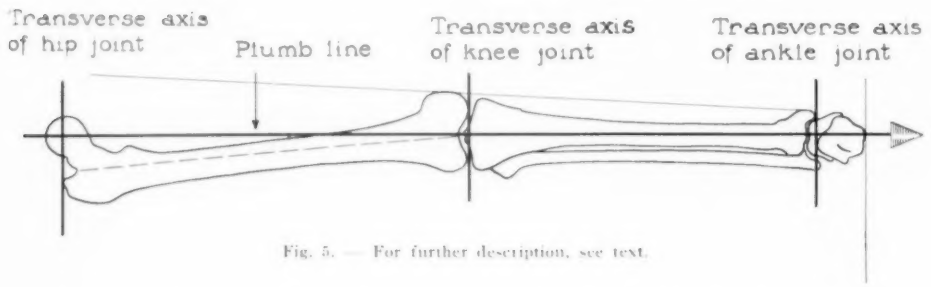

Fig. 5. — For further description, see text.

condyles at the knee joint. We are quite familiar with the fact that in a growing child a marked pes valgus may lead to a knock knee.

Faulty alignment of the joints of the lower extremity due to deformity of the foot, tibia, knee joint, or femur has a marked effect on all these structures. The joint structures are very sensitive to a faulty distribution of weight, especially if it is excessive and must be borne for long periods, and to all forces that act on the joint in an abnormal direction, thereby interfering with its functioning in the normal axis. When for any reason within or without the joint incongruence of the articular surfaces results, undue pressure will cause degeneration of the cartilage and open the field for an arthrosis. In the great majority of the painful chronic conditions of the knee joint discussed in this paper, faulty weight-bearing is an important etiologic factor. This is readily understood in the cases in group 3, but it is also true as a contributory factor in many of the cases in group 2, and some in group 1.

Treatment

In approaching the question of general therapy, we must first analyze the weight-bearing alignment of the entire extremity. A large number of cases will be found in which the chief fault lies in the position or the form of the foot.

Pes valgus or plano-valgus, and in rare cases pes varus must be corrected. This is usually accomplished by a foot plate, made to the plaster cast of the foot, with the object of forcing the heel into the line of gravity. The "fallen" longitudinal or metatarsal arch is of minor importance.

Before selecting the proper type of foot plate for this purpose, a simple test is made by strapping the foot and the entire lower leg with adhesive tape and Elastoplast. Dramatic results are frequently seen from a well done strapping of this kind. The Elastoplast bandage is applied after the leg has been raised for ten minutes in order to reduce the volume of blood in the venous system. A long strip of thin felt is placed along the tibial crest and the dorsum of the foot to prevent pressure sores, which might otherwise occur when the hydrostatic pressure rises with the patient in a vertical position. Even in cases of advanced osteo-arthritis of the knee joint this strapping will give remarkable relief, not only by securing proper weight-bearing for a limited time, but also by relieving undue strain from the muscles and by improving the circulation. If the strapping proves effective, we may expect a correct foot plate to be of considerable value.

Needless to say, gross deformities, such as bow legs, knock knees, and malunited fractures, should be corrected surgically if the patient's general condition permits. However, in a large group of these cases there will be no need for operative therapy, and the best alignment possible must be secured by conservative measures, such as foot plates or leg braces.

Proper alignment of the joints of the lower extremity takes care of one

important aspect of general therapy. Next we must discuss the possibilities of general treatment with regard to the constitutional or conditional causes of arthrosis. Overweight must be reduced to eliminate undue pressure on the joint; poor general circulation must be improved to afford better nutrition of the involved structures; endocrine disturbances require treatment with hormones; in fact every effective means, both physiologic and psychologic, of stimulating the patient's vitality should be tried. Recognizing the limits of such general therapeutic measures in an individual case, we must consider appropriate regulation of the patient's activities. It may be extremely difficult to handle such patients without the introduction of sufficient periods of rest and relaxation to give the structures under strain time to recover. This is just as necessary for the compressed cartilage and the stretched ligaments as for the overworked muscles. In our experience the best way to ensure proper rest periods at the right time is to schedule the local treatment for the middle of the day.

We now come to the treatment of the knee joint proper in the large group characterized by pathologic changes in the joint. We exclude those cases in which destruction of the joint has progressed to an extent necessitating an unweighting brace or a fusion operation.

The pain ordinarily is located well in the knee joint. There is more or less interference with function, and the x-ray shows the typical osteoarthritic changes in the early or the advanced stage. Physical therapy has many agencies to improve these conditions: application of heat from various sources, hydrotherapy, and exercise; also massage carried out by trained technicians under intelligent direction. Since we have found it a good plan to start with an intensive course of physical therapy over a short period of time, we subject these patients from the very beginning to a daily treatment of at least one hour. In selected cases, more vigorous initial measures may be indicated, that is to say, manipulation under general anesthesia in order to break down adhesions, injections into the knee joint of phenol camphor (Pavr), or continuous traction in bed.

In our experience the course of intensive physical therapy should be limited to two or three weeks. Since these patients are usually extremely chronic, and since the condition rarely disables them to a degree compelling abandonment of all activities, economic and psychologic considerations make it desirable to release the patient after the first course of intensive treatment from daily visits to the office or clinic. Furthermore, effective physical therapy puts such a strain on the patient and takes so much of his time that it seriously interferes with his occupational and social life. It is therefore important to find a method that may be carried out by the patient at home and while at work. For many years we have used two therapeutic measures which have given us such encouraging results that they have become our method of choice for the prolonged treatment of chronic arthrosis of the knee joint — *intermittent traction* and the *leatherstrip knee brace*.

Traction

The use of traction, or "distraction," for diseased joints was known in the early days of medical practice. It has been recommended from time to time, but has not received the general recognition it deserves. Twenty-three years ago the subject was carefully studied by H. von Baeyer, who, in a number of publications,[3, 4, 5] described in detail the effect of distraction on the joints, as observed in animal experiments and clinical practice. He found that traction of short duration produced a marked hyperemia of all the structures in the region of the joint, including the bones, down to a remark-

able depth; also in the muscles after removal of traction. To obtain this beneficial effect with its marked relief of pain, traction must alternate with relaxation at brief, regular intervals, hence the term "intermittent traction." We have used intermittent traction for chronic painful conditions of the knee and hip joint for more than fifteen years, and have found that the gradual, steady increase and decrease of weight — a sort of undulating traction and relaxation — is more effective than sudden alternations of distraction and relaxation.

Having established the value of this procedure, we tried to develop an apparatus which could be placed in the patient's hands for application. After a number of experiments we arrived at a satisfactory solution of the problem by designing the following apparatus (fig. 6).

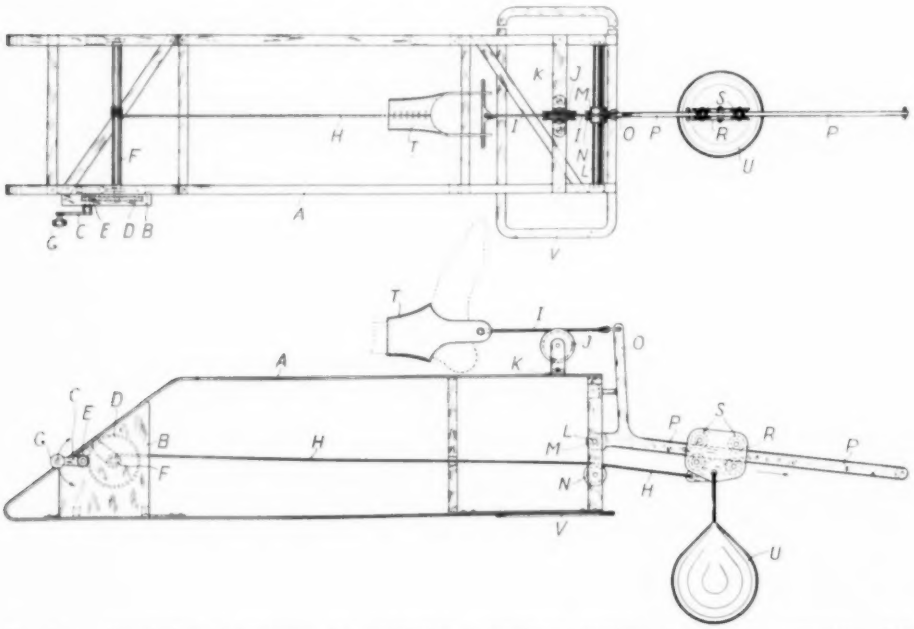

Fig. 6. — Description of apparatus for undulating, intermittent traction of the lower extremity. For explanation, see text.

A sort of Braun-Boehler fracture frame for the lower extremity is made from light metal according to the patient's measurements. The frame is covered with canvas or a flannel bandage. Traction is applied by a well padded, snugly fitting anklet, which the patient puts on before resting his leg on the frame. The traction is supplied by a sliding weight, such as is used in a weighing machine. As a rule it represents the initial traction of 10 pounds. The dosage may be adjusted according to the patient's weight and the condition of his joint. The sliding weight is moved against gravity by a string or cable which winds on an axis operated by the patient, by means of a crank and a tooth gearing. The weight slides down, following gravity, on the arm of a lever in an inclined plane, thereby increasing the traction to 15 to 20 pounds. The weight is gradually decreased by winding up the cable.

The frame is used in bed or on a couch. When traction is started, the patient slowly turns the handle, which releases the sliding weight until the maximum traction is reached, at which time he winds up the cable, gradually decreasing the traction. The steady increase and decrease of the weight results in an "undulating intermittent traction." This treatment should be applied once a day for about one hour, if possible at noon, thereby securing the desirable rest period in the middle of the day.

A daily treatment of one hour by undulating intermittent traction brings

relief to the patient, and in the majority of our cases has improved the condition of the osteo-arthritic joint. However, this treatment alone is usually insufficient to obtain the desired therapeutic result. This will depend largely on what happens to the knee joint during the many hours of weight-bearing when the patient follows his usual activities. Function of the joint within normal limits has to be considered as a valuable factor for the recovery of a normal joint. On the other hand additional damage to the diseased joint must be avoided. Therefore some means of fixation is necessary to eliminate undue strain, especially that of weight-bearing out of alignment and jerks in the wrong direction. Function should not be eliminated, but dysfunction must be reduced to as nearly normal movements and positions as possible.

Leatherstrip Knee Brace

Experience shows that the patient *desires* support and protection for his painful knee joint. With or without medical advice he frequently uses an elastic knee cap or an ACE bandage, or strapping for the knee. These appliances have the disadvantage of interfering with the circulation and the proper functioning of the muscles, leading to muscular atrophy, or increasing it if already present. In addition the support and fixation afforded is frequently inadequate.

The difficult problem of supporting the chronic painful knee joint and at the same time eliminating undue strain, excessive motion, and faulty alignment of the articular surfaces, without interfering with the desirable degree of function, or with the circulation, may be solved almost ideally by means of the so-called "leatherstrip" knee brace.

J. Fuchs, in 1921, introduced the leatherstrip technic, which he has since developed into a whole system of "technical operations in orthopedic surgery." Fuchs gave his system the name "*Orthokinetik*." In 1927, he published a textbook in which the underlying ideas and technical application are described in detail.[6]

Following Fuchs' method we have used the leatherstrip technic in several hundred cases, especially for the treatment of osteo-arthritis of the knee joint and similar conditions. The results have been so gratifying that we regard the appliance as one of choice for the prolonged ambulatory treatment of arthrosis of the knee joint, provided the indications are correct and the proper technic is used.

A typical leatherstrip knee brace (figs. 7 and 8) consists of five single transverse strips of soft leather, covering the region of the knee joint from approximately five inches above to five inches below the patella. The cross-strips are held in position by sewing them to two longitudinal strips fitted with eyelets for lacing. The proper fitting of this brace upon which the result depends, is a matter of experience, and somewhat difficult to describe. However, an outline of the technic will be given:

The bracemaker cuts the five transverse strips and the two longitudinal eyelet strips according to a standard pattern, with the variations necessary for the size of the patient's leg. With the patient lying down and the knee slightly flexed, the leather is stretched and moulded on the skin. The first strip is applied to the center of the knee, using surgical clamps or hemostats to assure tight fitting. When the first strip is in place, the knee is flexed and extended in order to find the correct situation of the strip in relation to the axis of the knee joint. Thereafter the two proximal and two distal strips are applied in a similar way, the strips overlapping each other like shingles. The position of the longitudinal strips with the eyelets depends upon the purpose of the brace, and varies accordingly. In some cases, for instance, limitation

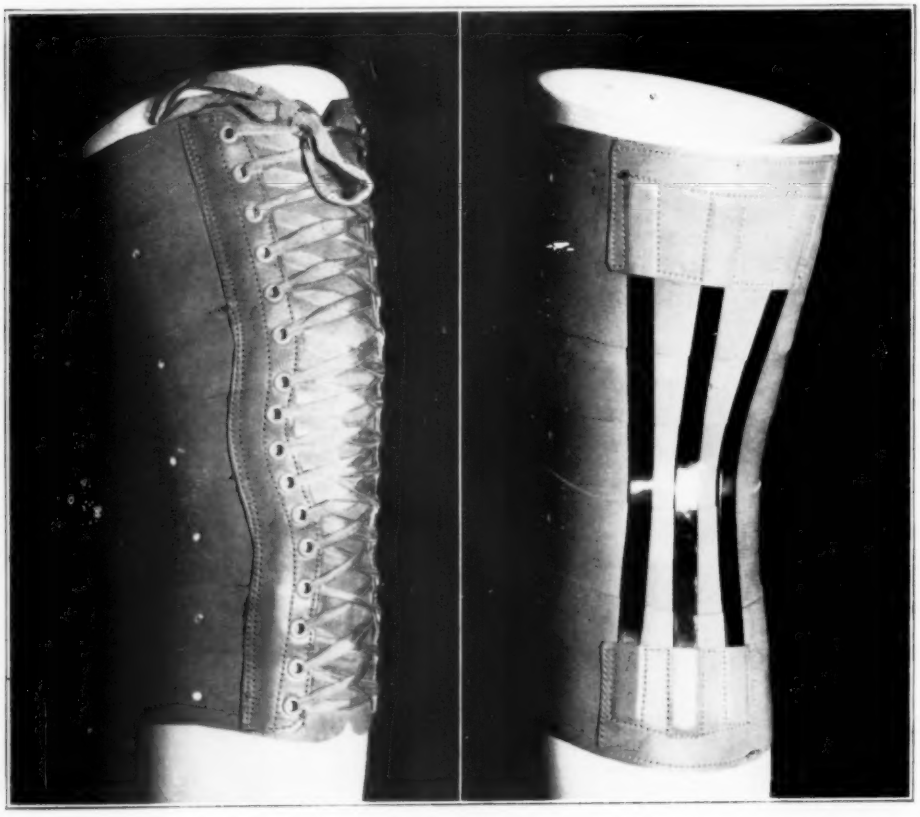

Fig. 7. — Leather strip knee brace. *A*, anterior view showing the longitudinal eyelet strips for lacing purposes. *B*, posterior view of the brace showing fixation device for fitting and insertions of three whalebone strips in back of popliteal space.

of motion and compression of an effusion are desired; in others, we aim at producing hyperemia of the knee joint.

The strips may be applied in such a way that a tendency to extension of the knee joint results, while in other cases, a tendency towards flexion, or limitation of a recurvation is possible. The brace permits the control of effusion, as well as an increase of synovial fluid through the production of hyperemia. It does not interfere with the proper play of the quadriceps, and therefore causes little, if any, atrophy of the muscles. Talcum powder is applied to the skin in abundance before fitting the brace to facilitate an easy gliding of the strips on movement of the knee joint.

Sometimes a higher degree of immobilization is necessary, as when an osteo-arthritic joint becomes acutely painful following a sprain or locking of the knee joint, and the like. For this purpose we have added a very simple fixation device by fitting the proximal and the distal strip with three small pockets at the back which permit the insertion of three whalebones in the popliteal space. The patient can insert or remove these whalebones whenever necessary. When in place, they permit of sufficient flexion and extension to make walking and sitting comfortable. They do not, however, allow lateral motion, as they do not bend over the edge, thus eliminating lateral strain on the joint.

The brace must be fitted by the physician or under his supervision, as the various indications for this appliance necessitate an individual adjustment that cannot be left to the bracemaker's judgment. Once the brace is properly

fitted, it requires practically no care, although it may be ironed out, if necessary. The patient is instructed to apply the brace in the morning while in bed, and he may wear it throughout the day. It causes no chafing or discomfort, provided the patient uses enough talcum to procure proper gliding of the strips.

Many of our patients have been using the leatherstrip knee brace for years. Some of them do hard work, and many have been spared recurrent disability due to strain and sprains of the osteoarthritic joint. The use of this brace has not been limited to osteo-arthrosis of the knee joint. It has been widely applied in the treatment of acute injuries to the knee and following operative procedures, such as for a torn semilunar cartilage or for recurrent dislocation of the patella.

Summary

1. Osteo-arthritis is the most common cause of chronic painful conditions of the knee joint which are frequently seen in general practice.

2. Early diagnosis of this condition is facilitated by improved x-ray technic. The "tunnel view" of the knee joint has proved to be a valuable addition to the routine x-ray examination.

3. Therapy should be directed toward the correction of faulty static conditions, which are an important etiologic factor. Local treatment is considered in two periods: the initial treatment by intensive physical therapy at the office or clinic for two or three weeks, and the subsequent prolonged treatment by the patient himself at home and while at work.

4. For the prolonged treatment, two successful methods are: (a) the daily application of "undulating intermittent traction," for which a new apparatus has been devised, with which the treatment can be carried out at home by the patient without assistance, and (b) the leatherstrip knee brace, which affords a certain amount of immobilization of the knee joint, as well as treatment, while the patient is following his usual activities.

110 E. 93 St.

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EXPERIMENTAL STUDIES ON SPECIFICITY OF SHORT WAVE DIATHERMY *

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NEW YORK

Though the value of short wave diathermy in the treatment of various disorders has been established, the mechanism of its action is not clearly understood. This is chiefly due to the fact that short wave diathermy has proved of particular value in local infectious processes for which only small energies are needed to produce results. Various hypotheses, such as point heating and the existence of a specific, athermic action have been advanced as an explanation.

The literature on this subject is quite large and it may suffice for our purpose to summarize the various ideas that have been advanced.

We may divide the authors into two groups. In the first are Pflomm, Schliephake, Liebesny, Dausset and Daugnon, Delherm, Weissenberg and Hunecke, who attribute the main effect of short wave diathermy to a specific and even an athermic effect. In the second group we find Malov, Raab, Coulter and Carter, Haber, and Hill, who accept the therapeutic results to be due solely to heat. Curtis and his collaborators take a strong stand against the theory of a specific, athermic action. The negative outcome of their own experiments coupled with the unsatisfactory replies obtained from the best known advocates of a specific action, lead them to make the statement, that "in the absence of evidence we consider that the great mass of inconclusive observations which has been presented is a very insecure foundation for the rapidly growing belief in a specific short wave therapy."

Marcer and Kowarschik take a middle stand. The latter states that short wave diathermy has predominantly a thermal effect, but he does not deny the possibility of a specific action. He adds, however, "One cannot assume that the specific action decreases, if one increases the field force. On the other hand, nobody will be able to maintain that depth heating harms, if given in correct dosage."

The basis upon which experimental work was undertaken was the previous publications of Pflomm and others. Pflomm, in his fundamental studies on the influence of short waves on the circulation of the frog web, has shown that the capillaries and precapillaries become dilated under the influence of short waves and remain so even for 1-2 weeks, while the arterioles were hardly changed. I have in various publications maintained that this effect is a sufficient explanation of the curative action of short wave diathermy. By dilating the blood and lymph capillaries the local circulation in the inflamed edematous tissue is improved through the increase of drainage. The increased drainage augments the influx of those substances which constitute the natural defense of the body against local infections. In brief, short wave diathermy has no direct influence on the etiologic factor, but only aids the defense mechanism. Cignoli and Olivieri showed in their experiments on the frog's tongue, web and mesentery that Pflomm's results were correct, and they made the additional contribution in demonstrating that the results depended also on the intensity of the applied energies. When they used stronger and longer exposures they observed complete stasis in the treated parts. They do not assume, however, any specific action of the

* From the Laboratory of the Manhattan General Hospital, and the Department of Physical Therapy, Neurological Hospital, Welfare Island.

short waves, but see in the effect an expression of the general physiologic law, according to which weak currents stimulate and strong ones depress.

The direction of my studies was determined also by clinical experience obtained in the treatment of edema. The results secured by short wave diathermy were far superior to those by other forms of treatment. This indicates that the former had a favorable influence on the local circulation, which in turn suggested that the same mechanism may be operating in inflammatory conditions of infectious origin.

Experimental Method

For this reason experiments were made in the Department of Physical Therapy of the Neurological Hospital in collaboration with Dr. L. E. Biro. We selected patients suffering from old severe ulcers of the leg and old injuries with pronounced chronic edema.

To determine quantitatively the effect of treatment, we measured the volume of the leg. For this purpose we had a container made with an outlet about 3 inches below the brim (fig. 1). The outlet was closed by a cork,

Fig. 1. — For description, see text.

the container filled with water at 97 degrees F. until it reached above the outlet. The cork was then removed and the water allowed to flow until no drop came out. The cork was then replaced. The patient was ordered to rest on a couch for 15 minutes as we had noticed that rest alone reduces the volume by 25-30 ccm. in 15 minutes. The patient was then asked to put the leg slowly into the container until the foot rested squarely on the bottom. The water was allowed to come to rest, then the cork removed and the overflow carefully measured. The displaced water represents the volume of the leg.

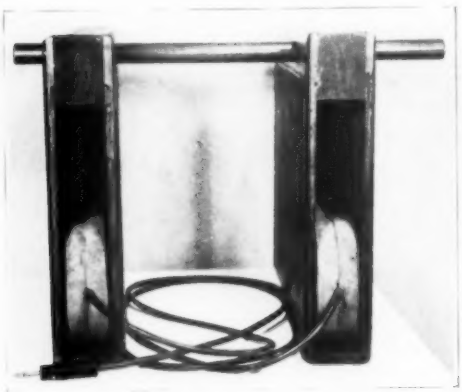
To assure as far as possible identical experimental conditions, the electrodes were applied by means of specially constructed wooden appliances (figs. 2 and 3) to insure a constant air space.

The treatments given in each case were as follows:

6-meter short wave diathermy, 90 watt energy, for 15 min.*
6-meter short wave diathermy, 270 watt energy, for 15 min.
15-meter short wave diathermy, low energy, for 15 min.**
15-meter short wave diathermy, high energy, for 15 min.
Conventional diathermy, for 20-30 min.
Radiant heat, for 30 min.

* The construction of the apparatus was such as to allow control of input. We were assured by the manufacturer that each step meant an increase of 90 watts in output.

** This apparatus had no arrangement to control the input. The intensity was controlled according to the sensation of the patient.

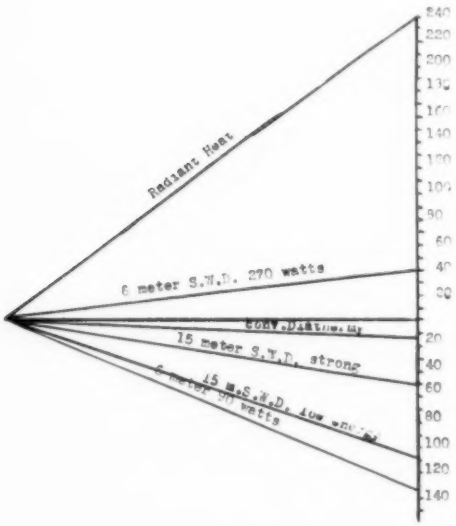


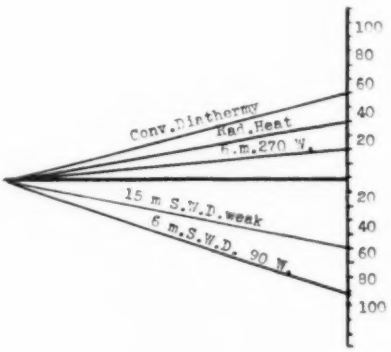
Figs. 2. and 3. — Specially constructed wooden appliances to insure constant air space.

The following charts show the absolute changes in the volume of the leg measured in ccm.

The figures show that in every instance (also in cases not included in this series) low energies decreased the volume considerably. High energies as a rule increased the volume of the leg, or decreased it only slightly.

We may conclude that short wave diathermy has no specific action, as opposite effects are produced by the use of the same wavelength but with different energies and the same effect by strong short wave diathermy, conventional diathermy or radiant heat.

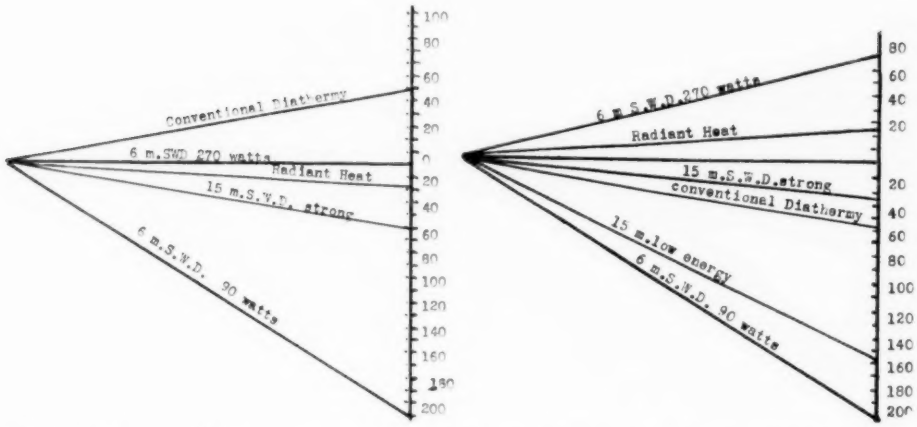




Charts 1. and 2. — Effect of varying intensities and wavelengths in a case of leg ulcer (left) and edema after fracture (right).

It seems, therefore, that so-called specificity lies in the reactivity of the tissues. The capillaries and precapillaries (venules and arterioles) have very thin walls and respond to very weak energies. This is in agreement with the experimental findings of Pflomm, Cignoli and Olivieri.

The arteries, however, have much thicker walls and therefore may respond only to stronger energies supplied by short or long wave diathermy or radiant heat. If treated with these agencies they become dilated and the inflow of blood increases. The capillaries become inhibited, stasis develops (Cignoli and Olivieri) and impairment of the local circulation results.



Charts 3, and 4. — Effects of varying intensities and wavelengths in edema from fracture (left) and leg ulcer (right).

This explains the statements so frequently found in the literature that high energies aggravate inflammatory conditions.

The experiments offer an answer to the question of optimum of duration of a treatment. Chart 5 illustrates the fact. The patient received

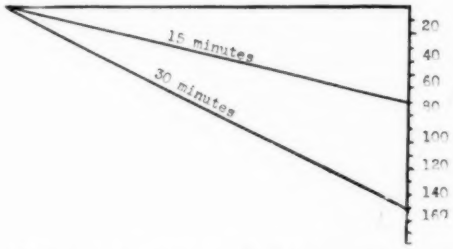


Chart 5. — Leg ulcer treated with 6 m. and 90 watt at different duration of each application.

a treatment with a 6-m. wave of 90 watts for 15 minutes. The volume decreased 70 ccm.; but when he was given the same wavelength and energy for 30 minutes, the volume was reduced by 150 ccm. The longer we apply such low energies the more prolonged is the dilating action of the short waves.

It may not be amiss, for the purpose of elucidation, to point to an analogy in the action of ultraviolet rays. It has been observed that the so-called erythema and pigment producing rays overlap, their maximum action lying between 2950 and 3100 A.U. It is hardly conceivable that rays of practically the same wavelength should have a double specific action, and it is more likely that the specificity lies in the type of cells which are affected. The capillaries of the skin become dilated by the rays which enter the *stratum Malpighi*, but on their way they also strike the pigment cells and stimulate them. When pigment cells do not exist or are rare (albinos and fair skinned persons) we can produce only erythema but no pigmentation.

These results seem to me to be of considerable importance. They are not only an additional proof that the length of the wave is of no importance in therapy, but also demonstrate why the intensity of application determines the effect of treatment. These experiments indicate that we have no need of a mystical specific action to explain our clinical observations, but that they

can be explained by very simple physiologic processes. Experiments are now being carried out in the laboratory to substantiate these findings on warm blooded animals.

Conclusions

1. The alleged specific action is due to anatomic differences of the vessels.

2. Short wave diathermy of very small energy is capable of dilating only the very thin capillaries and precapillaries, but not the thick walled arteries, while high energies are strong enough to dilate the arteries and thus interfere with the capillary circulation.

3. Wavelength *per se* is of no specific importance from the clinical point of view.

4. Strong short wave diathermy does not differ essentially from conventional diathermy in its action.

5. Intensive infra-red radiations have — at least in some pathologic conditions — the same effect as strong short wave diathermy and conventional diathermy, so far as volume increase is concerned.

6. A basis is offered to explain why short wave diathermy of low energy is more efficient in the treatment of local infectious conditions than application of high energy.

7. The effect of low energies increases with the duration of individual treatments.

667 Madison Avenue.

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ULTRAVIOLET RADIATION OF ERYSIPELAS *

J. G. JENKINS, M.D.

TEMPLE, TEXAS

The numerous remedies that have been employed in the treatment of erysipelas are falling into disuse because of the superior effectiveness of ultraviolet radiation. In 1928, I first used this agency to treat erysipelas. The result was so outstanding that some of the hospital staff doubted the correctness of the diagnosis. Since then we have repeated these results, so that this form of radiation is now given to all patients with erysipelas admitted to the Scott and White, and the Santa Fe Hospitals of Temple, Texas.

The technic of treatment is not difficult; however, to obtain the best results it must be given properly. Titus[1] emphasizes the need of intense dosage. He often found it necessary to give twenty times an erythema dose at one treatment in adults and six times in children under one year.

Several problems enter into consideration: (1) the time necessary to produce an erythema with a given burner; (2) the surface to be treated, since such exposed portions of the body as the face and hands require a longer time than the body proper, also patients with fair skin require less exposure than those with dark or olive skin; (3) the skin should be well cleansed before treatment. Often patients come in with ointments or lotions covering the affected part, and unless these are removed, the best results can not be obtained.

Technic

I always maintain the quartz mercury lamp 10 to 12 inches from the patient in order that he may have the advantage of the short rays. It is always well to see that the hood about the burner has been open long enough to allow excess heat to dissipate before the generator is placed over the patient. At 10 inches, skin-target distance, from two to four minutes is sufficient to produce an erythema just short of blistering. No harm is done where the dose is sufficient to cause bleb formation; in severe cases it is even beneficial. I do not treat large areas with one exposure. It is best to treat smaller areas and give several exposures. In one case involving the thigh and leg, eleven sections were treated. It is necessary to cover not only all of the affected area, but also to extend three or four inches beyond the margin. Where this was not done the lesion extended and a second treatment was necessary. After the treatment local applications, such as ice caps, compresses, or any form of medication, are not used on the treated area for at least twelve hours. It has been my experience that if local treatment is used within twelve hours, the desired erythema is not obtained. If after 24 hours the temperature has not reached normal or near normal, it will be found in the majority of cases that extension of the lesion has taken place. After the first treatment pain and tenderness are relieved, and the spread of the disease is definitely checked. The reason why ultraviolet radiation relieves the pain in erysipelas has not been explained. Troup[2] believes this is due, in part, to the analgesic effect on the interepithelial nerve endings.

Out of 50 consecutive cases of erysipelas treated with ultraviolet, 25 had only one treatment, the temperature returning to normal in two days.

* Read at the Fifteenth Annual Session of the American Congress of Physical Therapy, New York City, September 9, 1936.

Thirteen had two treatments, the temperature returning to normal in an average of 3.84 days. The remainder had three or more treatments. The entire group had an average of 1.9 treatments and the fever returned to normal and remained so in an average of 3.13 days. Nineteen had temperature from 103 to 105 degrees F. with a leukocyte count ranging from 10,000 to 39,500, an average of 15,000. Fifteen had a temperature of 101 to 103 degrees F. with the average leukocyte count of 11,000. Fifteen had a temperature of 100 to 101 and one 99.8 degrees F. It was necessary to give six treatments to a woman with erysipelas involving the face and scalp. She would not consent to having her hair clipped, and it was impossible to treat the scalp properly. Twenty-seven of this series had involvement of the face, neck and scalp; and 23 had involvement of the body and extremities. The cases of the face, neck, and scalp had fever for an average of .3 a day less than the one of the body and extremities.

Of the 50 patients one died, giving a mortality rate of two per cent. This was an infant twenty days old. The patient entered the hospital with a temperature of 104 degrees F. with involvement of the lower portion of the abdomen, both thighs, and one leg and foot. At first the infant showed some improvement, but on the fourth day it developed meningeal symptoms, and died on the sixth day. Patients admitted to the hospital with objective signs of erysipelas, as marked erythema with well defined border, but not presenting systemic symptoms, fever or an increased leukocyte count, are not included in this series.

Ude and Platou[3] in analyzing 402 hospitalized patients treated by various methods, found that ultraviolet irradiation appears to give the best results.

In reviewing 14 cases treated with remedies other than ultraviolet, I found the average duration of fever to be 8.04 days. Of course, this is a very small number, yet it provides material for comparison. In this comparison those cases not treated with ultraviolet had fever for an average of 4.91 days longer than those treated with ultraviolet. The number of days spent in the hospital was larger, and convalescence was slower.

Summary

1. Ultraviolet radiation for erysipelas has proved superior to other remedies.

2. The temperature is reduced to normal in a shorter time than by any other method.

3. After the first application the overwhelming majority of patients are free of pain.

4. The time of hospitalization is shortened.

5. Complications are rare.

6. The mortality rate is lower than that of any of the other methods of therapy.

3 East Avenue "A".

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Discussion

Dr. Norman E. Titus (New York): It is gratifying to see that the use of ultraviolet energy in treatment of erysipelas is being more widely accepted. There are a few points Dr. Jenkins mentions that I think can be discussed, but, of course, his results speak for themselves. In mentioning dosage he states that he uses his lamp at 10 inches for from 2 to 4 minutes. This description of dosage makes it impossible for everyone to accomplish identical results. I recommend the method of dosage used at the Medical Center as a more exact one than merely prescribing a certain burner-skin distance for a certain length of time. As all of us who use ultraviolet know, every lamp varies in its intensity of emissive power, and erythema production at the standard distance of 30 inches can be produced in periods varying from 30 seconds to 10 minutes. Consequently I have always felt that we should know the standard erythema dose of a lamp and then give so many times that dose. To determine the erythema time, all one has to do is test a lamp on an average skin, with 1 minute at 30 inches being accepted as the usual erythema time of a new lamp. Then, using this as a unit, so many times the erythema dose should be administered. For greater convenience it is frequently better to halve the distance which makes the lamp four times as powerful. As an example, with a lamp at thirty inches producing an erythema in 1 minute, if it is used at 15 inches for five minutes, we have 20 times the erythema dose. Each lamp should be marked with its erythema time and then multiples may be prescribed.

Dr. Jenkins asserts that local after treatment is not advisable for at least 12 hours. It is my feeling, as well as that of Dr. McGuinness who has worked with me in this field, that wet compresses tend to spread the infection and bring on recurrences, so I advise against them. It is much better to treat the burn the same as one would a bad sunburn. For the last year I have been using ozonated olive oil* as it is particularly effective in all kinds of burns. This gives immediate symptomatic relief from the severe sunburn that is induced.

What the sunburn does is still an open question. I had an interesting experience last winter when I was on pneumonia research service at Harlem Hospital. Two patients developed erysipelas. As both were colored men the question of the production of sunburn arose in the case of the pigment buffer of the skin. I gave the standard 20 E. D. to each of them, with the result that one entirely cleared up the next morning. The other, who had been two months in the hospital with empyema, a bloodstream infection and had passed through a grave form of primary pneumonia, required a second treatment. The skin on their faces peeled, but there was no sign of any blister formation or sunburn, as would be expected. The point I wish to stress is that the dose that was effective in white individuals was equally so in negroes. This leaves the question of the way ultraviolet works still very undecided.

I agree that it is desirable to irradiate three or four inches beyond the border of the erysipelas. Whether this is absolutely necessary, only time and research will tell because if the entire lesion is covered by a piece of cardboard and the skin six inches away from the lesion is well irradiated, the lesion will disappear. I observed this strange reaction on a child I treated, that had a severe cellulitis of the scalp and erysipelas extending beyond the scalp. I gave it one treatment of about 12 or 14 E. D. and the poor child looked so bad the next day I hesitated to repeat it on the head. I therefore gave 20 E. D. on the buttocks and lumbar region and the erysipelas promptly cleared up within 24 hours. This appears to me to indicate that the effects of the treatment are more general than local. The fluid in the oedematous skin is reabsorbed, and increases the resistance of the body to the existing infection.

* O.three, manufactured by Johnson Laboratories, N. Y.

EJECTION OF ALPHA-PARTICLE FROM WALL OF WILSON CLOUD-CHAMBER

R. A. WATTERS, F.R.S.A.

Director, The Dr. William Bernard Johnston Foundation for Biophysical Research

RENO, NEVADA

It has been pointed out in other papers[1,2] that ordinary matter contains in the neighborhood of 10^{-12} g Ra per g. This conclusion was arrived at, of course, by ionization methods, because the intensity of such minute quantities of radium is too weak to be studied routinely by the Wilson cloud-chamber method.

Insofar as I have been able to find, the ejection of an alpha-particle from the wall of a Wilson chamber has been mentioned but once in the literature. It was mentioned by Mott-Smith[3] who seemed to be doubtful of his findings, for he says "there is a short thick track which is probably also a proton but *may* be an alpha-particle from the side-wall." (My italics.) Since it is a fact that there are minute quantities of radium in ordinary matter, there is no reason why a ray-track should not occasionally be photographed, except that the chances of recording such a phenomenon are very remote; but, if at the right instant Fate is kind, the recording of a rarely occurring phenomenon should not be an impossibility.

Mott-Smith's ray-track,[3] differing not essentially from the track of any other alpha-particle pictured in the literature, was made with a Wilson chamber operating at pressures in the neighborhood of 12 or 13 atmospheres. Ethyl alcohol was used as a source of vapor, and his ratio of expansion was about 1.20 with air or other diatomic gas.

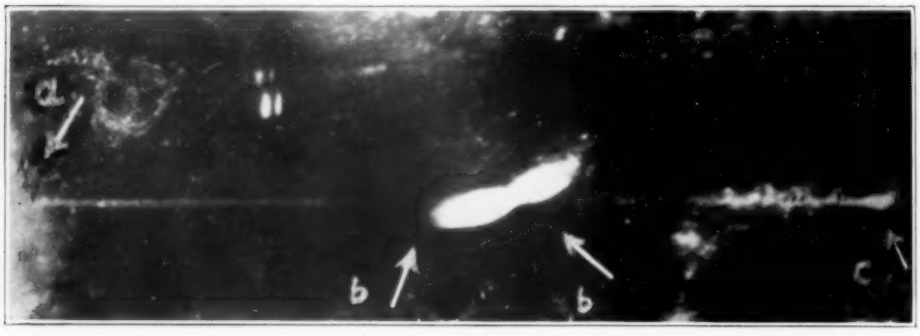

Fig. 1. — Alpha-particle from the wall of a cloud-chamber.

My photograph (fig. 1) was made with a Wilson cloud-chamber of the Locher type[4]. Water was used as a source of vapor; the gas used was nitrogen, and the ratio of expansion was 1.31. The gas in the compressed state was at atmospheric pressure; upon expansion it dropped to 150 millimeters below. Photographic exposures were made by *"photoflash" globes.*

At the time this photograph was obtained, the cloud machine was being used for work other than that of looking for radioactivity in ordinary matter. The photographing of this track was therefore due to chance, and it occurred

(Concluded on page 371)

ARCHIVES of PHYSICAL THERAPY, X-RAY, RADIUM

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Editor: DISRAELI KOBAK, M.D., CHICAGO

EDITORIALS

THERAPEUTIC EFFICACY OF ELECTROPHORESIS

The time is not far distant when physicians will be compelled to make use of iontophoresis in certain important types of acute and chronic inflammatory processes, if they are successfully to compete with the results obtained by workers with this therapeutic method. There appears to be a widespread notion that the technical conditions involved are associated with difficulties and that the effect of such synthetic preparations as histamine and mecholyl is something bordering on the mysterious. Yet nothing in physical medicine is more elemental in technic, nor is the effect of these drugs more simple to understand, provided one has a modicum of familiarity with the very history and fundamental action of the galvanic current.

Without entering into a detailed exposition of the early contentions and confusions about the nature of the galvanic current so far as it affects organic living material, it is not amiss to recall that both the exogenic and endogenic concepts of the direct current have been confirmed. From this basis to electroosmosis was but a step forward when it was recognized that the current tended to produce certain electrokinetic effects. The decomposition of water into its elemental state is a case in point, which led to the discovery of electroosmosis by Reuss[1] in 1808. While his observation is as true today as it was in his time, it is but natural that his interpretation of the concerned phenomenon has undergone radical modification. The concept of electroosmosis as pointed out by Abramson and Alley[2] elsewhere in this issue accepts the fact that the porous character of the skin when in contact with an aqueous medium through which a direct electric field is applied, results in an electric transportation of ions due to polar influences through and into the underlying tissues. The observation of this phenomenon is ascribed to Kühne[3] which opened up lines of investigation of the introduction of drugs for both anesthetic and therapeutic purposes. Accordingly the procedure commonly designated as cataphoresis is essentially identical

in effect with the concept of electroosmosis. Cataphoresis of a comparatively large number of drugs has been practiced for a long time, but fell into disuse due partly to its empirical employment and partly to the circumstance that equally efficacious effects could be obtained more simply and more rapidly by oral and parenteral routes.

With the recognition of the electric role played by the ions a further advance was made through the employment of certain drugs electrically transported to living structures. Histamine and other substances with positively charged ions were experimentally shown to possess certain physiologic effects to a degree above that attainable by the hypodermic introduction, if introduced into the tissues by cataphoresis. The term iontophoresis or the more appropriate term, electrophoresis, is therefore essentially identical with cataphoresis except that it stresses the role played by the ions.

Therapeutically the physiologic effects of histamine have been exploited to exert a favorable influence in arthritis and rheumatic affections, since it was noted that even exceedingly weak solutions of histamine produced when introduced by electrophoresis not only a profound local hyperemic, but to a certain extent at least constitutional effects. It is noteworthy that in spite of the numerous methods available for the treatment of the type of inflammatory processes under consideration, histamine electrophoresis has in the majority of instances been followed after but a few minutes of treatment by relief of pain and increased function of structures in and around the articulations which continued for hours or even days. It appears that similar favorable effects can also be obtained by the same simple technic in a large variety of inflammatory processes of the soft structures, including nerves, tendons, and bursae.

Of especial interest will be further observation of the effect of this drug on vasospastic conditions. When one considers that Kling and Sashin[4] as reported elsewhere in this issue have succeeded in obtaining 78 per cent of pronounced amelioration in such an intractable disease as thrombo-angiitis obliterans, then each physician should feel morally obligated to make use of this type of treatment, especially since the outlay in time and effort is minimal.

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ANESTHESIA IN ELECTROSURGERY

A fatal explosion which occurred this month in a famous institution during an operation for carbuncle of the neck was given nation-wide publicity by the lay press. We have ample evidence to substantiate the claim that this single news item has tempted some surgeons to give up electrosurgical procedures while others have been profoundly prejudiced against them. Regrettable as the accident is, it should not be allowed to be the cause of depriving patients of the benefits to be derived from the use of the high frequency currents for operative procedures without an impartial consideration of the involved circumstances.

So far as we have been able to ascertain the facts in the case, they are that a distinguished surgeon thoroughly familiar with electrosurgical technic was in the midst of excising a carbuncle when the anesthetist felt a shock on her arm, cried out and jumped from her stool, at which the explosion took place in the gas bag, the pressure of which ruptured the patient's lung. The precise cause of and the manner in which the explosion took place must remain conjecture. It appears that a well-known type of long wave diathermy was used, with the patient lying on the inactive electrode. It is difficult to determine whether this insecure contact was broken, resulting in the creation of a spark or "escaping electrical energy from the high frequency apparatus" which charged the operating table sufficiently to create an accumulation of static electricity, which resulted in a spark.

The problem is far from being a new one. Explosions have taken place when a thermocautery was used on patients anesthetized by ether. We know that flames have arisen during a number of operations performed with the high frequency current in fields close to the gas mask. Fatalities, too, have been reported. In the case under discussion, the anesthesia was produced by a mixture of ether, nitrous oxide and oxygen. As can be imagined the surgeon was careful enough to see that wet towels were placed between the mask and the operative field. No blame can be attached to the personnel, except possibly that absolute safeguards had not been taken, probably because after prolonged experience the conclusion was reached that the precautions taken were adequate. It is now realized that they were not, and that the calamity could have been averted if either the open method of anesthesia had been used or the anesthetic would have been switched to nitrous oxide and oxygen.

The answer to all this is not difficult. As long as we have to deal with electrical energies which are not under perfect control at all times, we should take every known precaution against the patient becoming charged or rather overcharged with electricity and that no electrosurgical operation should be performed with inflammable, let alone explosive materials in the operating room. Metal operating tables must be either heavily insulated, such as those provided with plate glass tops, or else a rubber cushion of adequate length must be interposed between the patient's body and the metal table top. The improper application of the inactive electrode has repeatedly led to burns, which could have been avoided had the surgeons in the case made sure that they were molded snugly to fit the anatomic contour and held fast to the back, abdomen, or limb, as the case may be, by simply bandaging.

The circumstance that the cables connecting the inactive electrode and the operating electrodes might get loose should ever be borne in mind, so that care should be taken before every operation to make sure that the connections are firm. Manufacturers could render in this respect a great service by providing set-screws wherever possible instead of tips to be fitted into a hollow.

The most important aspect of the problem, however, lies in the selection of the anesthetic. We have unfortunately no safe anesthetic for inhalation even without any reference to electrosurgery. Ether may be used, provided it is given in a room apart from the operating room as a preliminary measure, and even then no operation on the respiratory tract is permissible, as a fatal explosion of the residue is possible. All other operations can be performed if the nose and mouth of the patient are protected against sparking by wet toweling. But in the last analysis electrosurgery offers this advantage that it virtually compels the surgeon to produce analgesia or narcosis by other than peroral routes. While these too are not ideal from every point of view, they are at least free from the dangers lurking in am-

bush. There are available a large number of procedures that with a proper technic enable the surgeon to perform virtually every operation, and this irrespective whether one uses the scalpel and scissors or the high frequency current. So far as the latter is concerned it has a definite place in modern surgery that should not be abandoned because it involves several technical difficulties. These can and must be overcome, if surgeons do not want to be justly charged with being mere routinists.

MODERN TREATMENT OF ERYSIPELAS

In recent years definite advances have been made in the treatment of erysipelas, and though detailed reports of these methods have appeared from time to time in the current literature, a brief summary of the more important findings might be of value at this season of the year when erysipelas is most apt to occur.

Where x-ray is used the unfiltered rays are generally employed, giving not more than one-quarter of an erythema dose at each exposure. Often one treatment is sufficient to cause a drop in the temperature and general clinical improvement, but where the temperature does not remain down, this dose may be repeated on two successive days. In some cases where the infection is more deeply seated, the same dose is employed, but two to three millimeters of aluminum filtration may be used with increased effectiveness. In both instances it is essential to leave a margin of healthy skin at least an inch wide exposed to the rays in order to check the spread of the infection.

In the past few years ultraviolet light has been credited with equal if not more success than x-ray in the treatment of erysipelas and its greater availability still further enhances its value. When it was first employed, one or two erythema doses were considered sufficient to produce in many cases prompt and definite clinical improvement. Later Norman Titus advocated up to twenty erythema doses, and in August, 1935, Lavender and Goldman reported excellent results in twenty-six cases of facial erysipelas, each of whom had received an average of 18.8 erythema doses on three successive days for a total of 50.4 erythema doses. In a few of these cases where the temperature remained down after the first exposure, no further treatments were necessary.

This method has been found to be equally valuable in the treatment of infants and young children, and though the mortality rate still remains distressingly high in this group in spite of any therapy, it has been definitely reduced by the correct use of ultraviolet light. Nightingale and Starr in a comparative study of two groups, found that one and one-half erythema doses given on three successive days was more effective than any other method of treatment. They also found by comparison with an earlier group that ultraviolet treatment alone was as successful as when it was combined with blood transfusions, and consequently they discontinued transfusions in these cases as a routine measure.

In both adults and infants at least one or two inches of normal skin beyond the border of the infection should be left exposed to the ultraviolet light and it is thought advisable to have the burner not more than ten inches from the infected area in order to get a higher utilization of the short ultraviolet rays.

Following the more concenrated form of adult treatment, Lavender and Goldman recommended that a 5 per cent boric acid ointment may be employed with benefit on the treated area to minimize the amount of scaling and cursting. Other local applications of a soothing nature may also be used if necessary to add to the patient's comfort.

In conclusion: Three methods of treating erysipelas have been developed in recent years which have definitely improved the prognosis of this infection. Where x-ray or ultraviolet light machines are available, one of these methods should be employed alone, or in conjunction with intramuscular injections of the concentrated polyvalent erysipelas antitoxin. The first treatment should be given immediately after the diagnosis is made and repeated when necessary one or more times. At the same time topical applications may be appiled to sooth the irritated area and render the patient more comfortable. The other methods of treatment enumerated above have also given excellent results in certain instances and should be kept in mind and employed when one of the three methods of choice cannot be used. — Editorial, Kentucky, M. J. **34**:85, 1936.

Ejection of Alpha-Particles

(*Continued from page 366*)

in an area of the chambers somewhat removed from the site of the actual experiment.

The photograph (fig. 1) indicates that the alpha-particle was ejected from the wall of the chamber at (a) and traversed the moist gas to a point at (c), ionizing the atoms of the gas on its way thus leaving a heavy trail of ions in its path which became nuclei for the moisture drops. The light reflected by the moisture drops permitted the track to be photographed. (The symbols (b) indicate two defects in the glass top of the cloud-chamber.)

The track at (c) indicates that the alpha-particle collided with a nitrogen atom. At the point of collision the alpha-particle was evidently absorbed by the nitrogen atom, which phenomenon apparently caused the latter to recoil, thus producing a slightly ionized track of its own. The recoil has given to the track a negligible spur of unusual association indicating that the nitrogen atom was probably in the direct course of the approaching alpha-particle.

The track was actually 3 centimeters in length, which in animal tissue would be equal to something like 0.06 millimeter.

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SCIENCE, NEWS, COMMENTS

Columbia University Honors Dr. Victor E. Levine, a Scientist and Intrepid Explorer

Among the few outstanding individuals having received the scroll of honor for exceptional contributions in the fields of education, letters, biology and botany by the Columbia Graduate School Alumni Association this year was Victor Emanuel Levine, Professor of Biological Chemistry at Creighton University. It is a pleasure to recall that Dr. Levine, a member of the Congress, has in the past presented in our columns many of his outstanding contributions on the influence of light on nutrition. The Arctic littoral and the health problem of its people have in the past been and still continue to be the especial problem of interest to Dr. Levine. He has studied this region with many of the famous explorers as well as by himself, and brought back facts of scientific value and of ethnic interest. Last year his illustrated talk with factual material before the Congress, in New York, was a feature event of that program. Information is at hand that he is ready again to depart to the Arctic region for a full year to continue his medical and biological studies of the Eskimo. He is going this time with Father Hubbard, S.J., the famous glacier priest, the latter to make geologic and meteorologic studies, while Dr. Levine is to work along biologic lines. It is the intention of Dr. Levine to record by x-ray and electrocardiographic detail the tuberculous and nutritional status of the Eskimo child. In a private communication he states that he is in need of a portable x-ray unit to study the chest for tuberculosis and the bones of the wrist for its nutritional state. He is also in need of an electrocardiograph to reproduce and evaluate the presence of rheumatic fever and cardiac rheumatism of infants in the Arctic environment. It goes without saying that such hazardous and self-sacrificing labors should have the support of the civilized world. We feel certain that Dr. Levine's needs will be promptly met by manufacturers of such equipment. We wish him *bon voyage* and a healthy landing.

Pacific Physical Therapy Association Meeting

The regular monthly meeting for May was held at the Hollywood Hospital, May 26, and the following program presented: 1. The Arrangements for the Annual Seminar of Western Branch of the American Congress of Physical Therapy and Pacific Physical Therapy Association, *Clinton D. Hubbard, M.D.* 2. The Technical Aspects of Short Wave Therapy, *Victor Elcomin, Ph.D.* 3. The X-ray Differentiation Between Benign and Malignant Tumors of the Breast, *J. W. Warren*, M.D. 4. The Diagnosis and Treatment of Pituitary Tumors, *P. F. Guernsey, M.D.*

Carbon Dioxide a Vital Need; Once Thought Mere Waste

Carbon dioxide, commonly looked upon as nothing but a "waste" product of bodily processes, is "almost as essential to the normal functioning of the body as is oxygen."

This challenge to a long-established tradition of biology was thrown down before the meeting of the American Philosophical Society in Philadelphia, by one of the world's leaders in research on respiration, Prof. Yandell Henderson of Yale University.

True, carbon dioxide is a waste product of respiration, just as it is of the burning of coal, oil or wood; most of it must therefore be got rid of. But it is an error to think that any considerable residue left in the body is a poison, Prof. Henderson contended. A certain amount is absolutely necessary, because carbon dioxide is "the normal stimulus to the circulation as well as to respiration."

Supporting evidence for Prof. Henderson's claim was found in troubles sometimes encountered with hospital patients going under anesthesia. Some patients breathe excessively in the early stages of anesthesia, and thereby decrease the carbon dioxide concentration of the blood. This condition, called acapnia, may result in failure of both circulation and respiration. This tendency to collapse is now counteracted and prevented by the inhalation of carbon dioxide, diluted with oxygen or with air. Also, at the end of the operation, inhalation of carbon dioxide is now the accepted means of speeding up the elimination of the anesthetic and preventing difficulties with the patient's lungs. The same means of stimulating breath and circulation is now used in resuscitating victims of carbon monoxide asphyxiation, and as a better substitute for the time-honored method of spanking new-born babies who fail to start breathing.

The American Philosophical Society, whose annual meeting Prof. Henderson thus inaugurated, is the oldest scientific body in the United States. It was founded in 1727 by Benjamin Franklin, in the days when "philosophy" was considered as embracing all natural knowledge, and hence, as properly including all the sciences. In keeping with this tradition, therefore, the three-day meeting in the Philosophical Society's building immediately alongside Independence Hall, featured discussions of historical, economic and literary matters, as well as an impressive array of strictly scientific papers. — ***Science News Letter.***

THE STUDENT'S LIBRARY

LIGHT THERAPY. By *Frank H. Krusen*, M.D., Associate Professor of Physical Medicine, Mayo Foundation of University of Minnesota; Director, Section on Physical Therapy, Mayo Clinic, Rochester, Minnesota. Second Edition. Cloth. Pp. 258 with 42 illustrations. Price, $3.50. New York: Paul B. Hoeber (Medical Book Department of Harper & Brothers), 1937.

Contributions in the fields of photodynamics and light therapy have in recent years been so consistently brilliant and practical as to raise this branch of therapeutics beyond any point of controversy. Phototherapy, incorporating in its classification and practice the spectral energies ranging from the infra-red to the shortest wavelengths of ultraviolet radiation, has therefore come to be regarded as the most staple therapeutic commodity in the domain of physical medicine. Any intelligent and conservative interpretation of the mass of information that has accumulated in this study is of importance to every physician and must be regarded as of timely service to our profession. It will be recalled that Krusen's past literary effort in this problem resulted in a publication that was lauded both for its conservative attitude and for the meticulous evaluation of the data incorporated. That book laid the foundation for the broad expansion of his increasing experience as is evidenced in the liberal revisions and increasing size of the present edition. Outside of the fact that Krusen has introduced and evaluated the scientific background and clinical usefulness of light for therapeutic purposes, he has rendered a greater service by pointing out its fallacies and limitations. In the space of twenty-one richly illustrated chapters the author has critically interpreted the history, physics, sources, technics, physiologic effects, and therapeutic indications and limitations of the administration of radiant heat, light and ultraviolet. In his effort to render his deductions and conclusions more authoritative, he has leaned rather heavily on the opinions of Laurens and Coblentz, two individuals who have acquired ranking authority by their respective contributions in this branch of radiation. While he is to be felicitated on the simplicity, of his literary exposition, reducing technical exposition by practical illustrations, there are those who no doubt will be annoyed at the outline method of utilizing clinical source opinions. By so doing the author assumes responsibility for the outside opinions incorporated in the text. One such example to be challanged is the statement by Coblentz that in the differentiation between the changes produced by infra-red and ultraviolet, the latter reaction is followed by an eventual pigmentation while in the former only an immediate erythema is noted (page 62), a conclusion not based on fact. Deep pigmentation is a characteristic effect of infra-red radiation. It may also not be amiss to point out in the interest of refinement of method the general fallacy of ultraviolet dosimeters, including the one especially recommended by the author. The general mistake of all is that they have failed to appreciate the importance of angle irradiations according to the cosine law of Lambert. To do so requires but a simple addition of a central metal pillar to any such instruments as a guide to correct tangential shadows during irradiation. This was pointed out by Kobak in 1925. With the exception of some minor errors such as reviewed above, this book incorporates the most authoritative and conservative opinions on the clinical usefulness of light therapy for both physicians and students of scientific medicine.

DIE PRAXIS DER PHYSIKALISCHEN THERAPIE. Ein Lehrbuch für Ärzte und Studierende. *Von Dr. A. Laqueur*, Professor und Direktor der Abteilung für Physikotherapie im Staatl. Musterkrankenhaus Ankara; und *Dr. J. Kowarschik*, Primararzt und Vorstand des Institutes für Physikalische Therapie im Krankenhaus der Stadt Wien. Fourth and enlarged edition. Pp. 426 with 234 illustrations. Price, 24. and 25.80 Rm. Vienna: Julius Springer, 1937.

This work should be especially welcome to those who have long recognized the authoritative contributions of Laqueur and Kowarschik to the literature of physical therapy. Their names associated with any scientific effort is a guarantee of its critical and intelligent evaluation. The present edition provides a new literary partnership and affords the physician and student of physical medicine the double advantage of having two pioneers and recognized authorities critically to evaluate the many agencies in this discipline on the basis of their rich experience. Even though the work professes co-authorship in effort, yet there is noted a distinct division of labor. Laqueur apparently has written the sections on mechano- and hydrotherapy, manual massage and the various forms of light therapy, while Kowarschik has limited himself to electrotherapy — that is to say, to the agencies which are utilized under the classification of low voltage current, diathermy and short and ultrashort wave therapy. The anticipation that these divisions of physical therapy practice would be discussed in a critical, conservative and concise style, is fully confirmed. The volume is divided into two parts, the first dealing with the physical and physiologic characteristics of the agencies utilized and their technic of application; the second discussing the clinical uses and the combination of methods most suitable for certain diseased conditions. Theory and practice receive well balanced consideration, the first section devoting its major effort to an evaluation of the physiologic possibilities of hydro- and thermotherapy, light, electricity, mechano- and manual

therapy, and the natural physical resources encountered in suitable environments; while the second part is strictly limited to the expansion of these forces for the benefit of certain indicated clinical entities. From a literary point of view, the authors have utilized the concise, or terse style of discussion, limiting their exposition to factual possibilities of physical methods and eschewing borderline speculations in both theory and clinical practice. The cooperation of these distinguished authors to present their rich experiences into a single volume is therefore a welcome and timely contribution. It but needs to be translated into English to enjoy the widest reception it so richly merits.

FOOD AND THE PRINCIPLES OF DIETETICS. By *Robert Hutchison*, M.D., LL.D., F.R.C.P., Consulting Physician to the London Hospital and to the Hospital for Sick Children, Great Ormond Street, and *V. H. Mottram*, M.A., Professor of Physiology at King's College of Household and Social Science, University of London. Eighth Edition. Cloth. Price $6.75. Pp. 634. Baltimore: William Wood and Company, 1936.

Since its first publication in 1900, this book has been reprinted sixteen times. Such a record indicates the substantial value of this volume. There is an introduction to the history of dietetics, which shows that although this is really a very young branch of science, some attention was given to the feeding of the sick in our earliest history. It was with the dawn of Greek medicine, however, that the first beginnings of dietetotherapy may be discerned. This volume covers completely our present knowledge of foods and the difficult problems of nutrition. It considers the nature, nutritive constituents and relative value of foods, the amount of food required in health, the influence of foods on various conditions, the principles of feeding in infancy and childhood, some dietetic "cures" and "systems," and artificial and predigested foods. In the chapter on artificial foods most of the products considered are not known in this country. This book is indispensable as a source of fundamental food knowledge. It is regrettable that a very small amount of space is devoted to therapeutic diets. Physicians are now paying especial attention to diets, but attention is likened to the finished musician who would decry his pupil playing compositions before having a thorough grounding in the fundamentals of music. Too often physicians believe that prescribing a corrective diet is a simple matter, and by referring to worked out diets the problem is considered solved, very little or no attempt being made to schooling in fundamentals. It behooves every physician and especially those reluctant to share their responsibilities of diet prescription with the dietitian to supplement his all too cursory knowledge of foods with a mastery of the principles of nutrition, as presented in this scientific and informative volume.

KLEINE CHIRURGIE. Von Dr. *Ludwig Moszkowicz*, Privatdozent für Chirurgie an der Wiener Universität. Second completely revised, enlarged and improved edition. Cloth. Price, 15 Rm. Pp. 244 with 188 illustrations. Vienna: Wilhelm Maudrich (American Agency: Chicago Medical Book Co., Chicago), 1937.

Apart from the lack of unanimity of opinion as to what constitutes minor and what major surgery, the majority of manuals or text-books dealing with the minor problems of surgery suffer from a uniformity which precludes what is most desirable in any technical work — individual characteristics. It is therefore refreshing that Moszkowicz has deviated from standard patterns and has gone his own way which reveals many original ideas and presentations. What is perhaps of greatest importance to all who have to perform minor surgical operations and certain non-operative manipulations is, that the author has based the present volume on a rich clinical experience which he has evaluated in a severely critical manner. The text covers a large field, including *inter alia* the management of wounds, infections, ulcers, fistulae, certain inflammatory processes and neoplasms, varicose veins, hemorrhoids, minor plastic surgery, certain orthopedic procedures, not excepting those urologic treatments that can be carried out in the office. The technics of aspiration, venesection, blood transfusion and of the diagnostic application of proctoscopy are some of the features which merit especial mention, because they can be accepted as a safe guide. The description of the diverse technical steps does not materially differ from the manner in which postgraduate instruction is given to physicians in the Austrian university. Those who have a working knowledge of medical German will greatly profit from a careful perusal of and frequent reference to the small but weighty volume.

THE PRACTICAL MEDICINE YEAR BOOKS OF 1936: UROLOGY. Edited by *John H. Cunningham*, M.D., Associate in Urologic Surgery, Harvard Post Graduate School of Medicine. Cloth. Pp. about 450 with illustrations. Price $2.25. Chicago: The Year Book Publishers, 1936.

The 1936 Year Book of "Urology" maintains the excellent standards set in the previous volumes. The abstracts are well presented, and cover the subjects very well. A complete review is presented of all worthwhile material. The subject is handled in the main as a division of surgery. Increasing lay discussion on venereology is rapidly reviving interest in this branch of therapy. The 1936 edition reviews the major contributions in this field, and should be in the hands of any one interested in the subject.

INTERNATIONAL ABSTRACTS

Quartz-light Erythema Doses in Diseases of the Anterior Sector of the Eye. L. Shereshevskaya.

Sovyet. Vyestn. Ophthalm. 9:193, 1936.

The author radiated with the quartz lamp various affections of the anterior part of the eye at a skin distance of 25 cm. and a duration of 5 to 12 minutes, producing a dosage considerably above that for the production of erythema. Most often the affected eye only was subjected to radiation, but in a few instances the area was extended to include the neck and the upper cervical vertebrae, which method did not prove as effective as when the radiation was restricted to the eye. Eighteen cases of corneal ulcer were radiated, 6 of which affected with ulcus serpens were not benefited, while in the other, protracted cases one soon noted disappearance of the photophobia, lachrymation and pains. The ulcers cicatrized. Of 7 patients suffering from infiltration of the cornea 4 showed a satisfactory response. Of 10 patients treated for eczematous kerato-conjunctivitis 7 who had also eczema of the face were greatly benefited, while the remainder in whom the eczema was limited to the eye were not improved. Similarly, no effect was seen in 2 patients who had sustained burns of the eye from lye. The treatment was also given to 23 patients suffering from iritis with negative results. In all these cases tuberculosis could be definitely excluded. In 17 patients with articular disease as the etiologic factor 4 remained unaffected, in some of the grave cases there was attained pronounced amelioration, while in 8 cases cures were obtained after a course lasting from 8 to 12 days. The author explains these results through influence on allergy or through the amount of histamine-like bodies which are liberated.

Prophylactic Ultraviolet Radiation of Fissured Nipples. A. Baron, O. Kossovskaya, and M. Najdich.

Akush. i Ginekol. 9:1067, 1936.

The authors have treated 125 patients previous to delivery by prophylactically radiating the mammary glands with ultraviolet light. The applications were made every other day beginning with a one minute application with a one minute increase in duration on every application, the patients receiving from 10 to 20 radiations, the last ones having accordingly an exposure of 10 to 20 minutes, respectively. Fissures appeared in only 14 patients of the series. Of these 5 had the trouble immediately after confinement, 6 manifested them within 2 weeks after delivery, and the remainder developed them as late as two and one half months post partum. In none of the patients was there any evidence of mastitis.

The authors regard ultraviolet radiation of the breasts an effective prophylactic measure against fissure of the nipple and mastitis, but leave open the question whether this favorable effect is to be ascribed to the formation of a pigment or to the bactericidal properties of ultraviolet light.

Removal of Tonsils by Electrical Currents of High Frequency. Albert Eidinow.

Brit. M. J. 3916:152, 1936.

Removal or destruction of the tonsils by the application of high frequency currents has certain advantages over other methods of tonsillectomy. Theoretically the active electrode produces the combined effect of cutting and coagulation; the operation should be bloodless, since the heat generated coagulates and seals off blood vessels. The lymphatic vessels are similarly closed and, since the local heating effect is great, infective organisms within the tonsils are destroyed; the risk of spread of infection, therefore, should be greatly lessened.

The tonsils may be removed by means of one of two methods: (1) complete removal at one operation under a general anesthetic, or (2) progressive destruction of the tonsils by treatment once a week. Each tonsil receives treatment at intervals of twelve to fourteen days. Each method has its advantages.

The older methods of treatment, described by Dan McKenzie and Bulmer, involved the use of specially designed electrodes of many varied sizes and patterns. These electrodes are too large, being about 3 mm. in diameter and 1 cm. long. The improvement in diathermy apparatus which now generates electric currents of higher frequency, and the use of a much smaller active electrode (0.2 mm. in diameter and 2 mm. long) result in a more defined and regular area of coagulation, diminishing the danger of tearing the tonsil and surrounding tissues. The older methods do not allow such high energy to be applied, and the coagulum sticks to the electrode, being partly detached and pulled away from the tonsil when the electrode is removed. The apparatus should be kept switched on during the whole process of treatment; it is not switched off until the electrode has been removed from the tonsil.

The number of treatments depends upon the size of the tonsil and to some extent upon the behavior of the patient. With nervous patients and those who resist and are irritated by manipulation of the mouth and tongue, it is necessary to proceed slowly, and to be satisfied with slow progress at each treatment. The small, hard, fibrotic and adherent tonsils seen in elderly people, and the remains of tonsillar tags following incomplete tonsillectomy, respond well to this method of treatment.

The danger of hemorrhage is not great; it com-

pares favorably with the incidence following surgical tonsillectomy. Hemorrhage may occur within forty-eight hours after treatment; this is rare, and is due to straining of the throat and palate, causing detachment of the slough and damage of the blood vessels. It can usually be arrested by the application of the active electrode or fulguration of the bleeding point. Hemorrhage may also occur five to seven days after treatment, owing to premature separation of the slough and coagulum or to bleeding from granulation tissue. Fulguration of the affected area is usually sufficient to arrest and control bleeding.

Fever Therapy. Charles A. Doan, M. M. Hargraves. With the technical assistance of Olga S. Bierbaum, and Lucille Kester.

Hospitals **10**:88, 1936.

Doan *et al* observed a rather consistent cytologic response to fever, the majority of the cells that made up the concomitant leucocytosis being polymorphonuclear neutrophils delivered by the bone marrow. This part of the reaction may well be nonspecific and is by no means necessarily the most important from the standpoint of the fundamental defenses of the body. There is probably a destruction of lymphocytes by the hyperpyrexia or by some associated phenomenon as attested by the return to the circulation, after a prolonged lymphopenia, of very young cells. There is probably some destruction or redistribution of monocytes as is shown by a delayed monocytosis made up primarily of younger forms. Malaria and typhoid differ from hyperthermic induced hemograms by the marked leucopenia observed during the chill, by the disappearance of the monocytes from the circulation in typhoid, by the marked stimulation of the monocyte in malaria and its moderate stimulation with typhoid. The "shift to the left" in the neutrophilic granulocytes in malaria is outstanding and the appearance of clasmatocytes in the peripheral blood has been observed with no other type of fever study.

The significance of the cellular changes described remains to be appraised in terms of serologic and clinical data being accumulated. If the free cells of blood and tissues play any role of importance in the beneficial therapeutic results in fever therapy it is clear that the various methods of accomplishing this end must be carefully scrutinized and evaluated in terms of these reactions. Only as the fundamental mechanism underlying each diseased state is determined, and the influence of fever on the various physiologic and pathologic functions of the body is established, may we hope to know more fully the uses and the limitations of fever therapy in human disease.

Calcium Metabolism and Therapy in Dermatology. E. S. Lain.

South. M. J. **29**:626, 1936.

Lain finds that the most gratifying effects of adequate and properly administered calcium therapy are that:

It produces a degree of sedation and stability of the sympathetic nervous system, thereby serving to give immediate relief in most acute or chronic pruritic dermatoses.

It limits to a striking degree exudation from either mucous or cutaneous structures, whether the irritant is due to internal or to external factors.

Administered intravenously, after the first flush of warmth passes away it gives immediate tone to the tissues, both cutaneous and muscular. There soon occurs a feeling of well being somewhat like that from a narcotic drug, without the unpleasant after-effects.

When it is given in conjunction with viosterol and foods high in vitamin D value, with an adequate exposure to ultraviolet radiation, it promises to be of special value in other skin eruptions which have for their etiologic background disturbed calcium metabolism.

By making this presentation the author hopes to stimulate more interest among dermatologists for a closer cooperation between the physiologic laboratory and the clinician, whereby the establishment of calcium therapy on a rational basis with a full knowledge of its values and limitations may become a reality. — J. A. M. A. **107**:623, 1936.

Therapeutic Pyrexia by Means of Short Radio Waves. F. J. Nattrass, and S. F. Evans.

Quarterly J. Med., **5**:18, 187, 1936.

An account is given of the development of electrical methods for the production of therapeutic pyrexia. A description is presented of the essential features of an apparatus for the production of general pyrexia by means of short radio waves, and the technic outlined. The results of the treatment are discussed in fifteen cases of dementia paralytica, three cases of tabes dorsalis, and two cases of sub-acute combined degeneration of the spinal cord. As regards dementia paralytica, the conclusion is reached that the results compare favorably with those of malarial therapy, and that the electrical method is the safer, and capable of more precise control.

Ionization Treatment of Hay Fever. C. Shields.

Practitioner **136**:645, 1936.

Shields shares the general prejudice against the introduction of drugs through the skin by ionization. First, because their action in the quantities in which they are applied must be very slight, owing to the "flushing" action of the blood and lymph streams; secondly, because they are more efficiently administered in properly controlled dosage by other routes. The problem of intranasal ionization is, however, different, for here the effect is entirely local and the nasal mucosa can be impregnated with an insoluble substance which remains local for several hours. On theoretical and practical grounds, intranasal ionization of zinc sulfate is a justifiable and valuable method of treating hay fever and vasomotor rhinorrhea. It has been suggested that the beneficial effects of intranasal zinc sulfate ionization may be due to the sedative action

of anodal galvanism and not to the impregnation of the mucous membrane with zinc in ionic form. Therefore, the author has given four applications to patients with hay fever, using gauze soaked in sodium chloride solution and employing the same amount of current for the same time without the patient being aware of any alteration in the technic. The characteristic symptoms of increased salivation and conjunctival injection were not seen, and there was no delayed reaction and no improvement in the original condition following this treatment. — J. A. M. A. 107:465, 1936.

A Quantitative Study of the Action of Ultraviolet Light on Bacteria. Georges Dreyer, and Margaret L. Campbell-Renton.

Proc. Royal Society, Series B. 120:819, 1936.

Experiments on different species of infusoria carried out by Dreyer (1903), using the carbon arc as a source of light and different filters, showed that, although the greatest lethal effect was always obtained in that part of the spectrum which passes through glass, the relative sensitivity of different fusoria varied considerably in different parts of the spectrum.

Agar plates of different bacteria were exposed to a mercury vapor lamp and the percentage of growth after 22 hours' incubation calculated from readings made with a special apparatus. With certain exceptions there was a difference in the shape of the curve for different bacteria. The bactericidal effect in the spectral lines was not proportional to their relative energies. Over a certain range the effect of reducing the intensity of light by screening showed that the time required for a given bactericidal effect was inversely proportional to the intensity of the light.

The relative bactericidal effect in the spectral lines appeared to vary according to the microbe exposed, but in all cases the line 2655 A was the most effective, followed in order by the lines 2536, 2864, 2482, and 2700 A. The curves for some disinfectants on two species of microbes were determined, and a stimulation of growth in the higher dilutions was observed. Experiments with bacteria sensitized with erythrosin and exposed to both the long and the short wavelengths were made, and differences in effect in the different lines were observed. With the microbes used, it was found that the gram-positive organisms, showed a much greater degree of sensitivity in the long wavelengths than the gram-positive.

Thermometallic Ionization in Old Otorrheas and Some Other Otolaryngologic Cases. Y. de Kerangal.

J. de méd. de Paris 56:79, 1936.

When metals are heated their surfaces emit particles which the author calls ions and insists they are identical physically with the ions developed by the passage of a direct current through a solution of an electrolyte. With this hypothesis, the metal is heated electrically or in an alcohol flame, and a current of air is passed over it onto the diseased tissue surface. Such an air current is purported to result in a leukocytic response, a specific metallic bactericidal effect and a drying of exudates. Fourteen cases of intractable chronic mucosal disease in the upper respiratory tract are reported as cured after two to five "ionic insufflations." For nasopharyngitis silver is advised, for ear conditions copper, and in tuberculous otitis gold effected a rapid cure. The passage of the metal bearing air takes but two minutes and is at a temperature comfortable to the patient. The author feels that this method is particularly valuable in gold therapy where other methods of administration are contraindicated.

Indications for Ray Treatment and for Surgery in Fibromyomas of Uterus. C. Béclère.

Strahlentherap. 56:548, 1936.

Claude Béclère points out that Antoine Béclère said in 1912 that roentgen therapy can be tried in nearly all fibromyomas of the uterus, without consideration of form and size of the tumor and of the age of the patient. To be sure, a correct diagnosis of fibroma is an absolute requirement. The author thinks that, if the height of the tumor above the symphysis is regularly measured at intervals of eight days an erroneous diagnosis will soon be discovered, ray therapy can be interrupted and an operation can be done. In an evaluation of the advantages and disadvantages of ray treatment and surgical treatment, the author lists the following factors as the advantages of roentgen therapy; absence of mortality, absence of pain and no interruption in the working capacity. The disadvantages of roentgen treatment are the possibility of a diagnostic error, incomplete reduction of the tumor and possibility of later complications. In discussing surgical treatment, the author mentions as the chief advantages that it verifies the diagnosis, that it makes a myomectomy possible, that it permits the complete removal of a tumor no matter how large and that it permits a radical treatment which will prevent later complications. However, these distinct advantages involve just as great disadvantages, namely, mortality, pains and interruption of the working capacity. Further, the author gives his attention to the indications for roentgen therapy as well as for operation and then discusses the complications that arise during and after treatment. In the difficult differential diagnosis of the uterine hemorrhages after completion of the treatment, the persistence or cessation of hot flushes is an important symptom. The author says that Antoine Béclère directed attention to this symptom and demonstrated that it permits a decision as to whether the hemorrhage is only a return of the menstrual flow or an abnormal metorrhagia. Thus it will be known whether the irradiation should be resumed or avoided or whether a secondary carcinoma of the corpus uteri should be searched for. — Abst. J. A. M. A. 107:1767, 1936.

Electro-Urethrotomy in Treatment of Urethral Strictures. Leander William Riba.

J. A. M. A. **106**:1971, 1936.

This electro-urethrotome is not presented as a panacea for all urethral strictures. It has been found very useful in the fibrotic, resilient and undilatable types. The operation is not recommended to displace the use of urethral sounds or bougies. In large caliber strictures and urethral infiltrations, it undoubtedly has little value. In patients, however, who fall in the groups named, an electro-urethrotomy may fill a needed niche, particularly from the standpoint of the patient. For an individual who has a strictured urethra and who for some reason or other (renal colic, hematuria or injuries) needs an immediate cystoscopy, this method would seem more rational than the usual avulsion of the stricture, which is so frequently resorted to.

This operative technic has seemed so much simpler than that of other urethrotomies now in general use that it may replace some of them to a certain extent. In most instances this operation has a lower morbidity and mortality and necessitates fewer hospital days. Postoperative sounds should be passed as a routine procedure, preferably after three or four weeks. With a few exceptions, these sounds were very readily passed. There was no indication that more scar tissue was apt to form following this operation. In reality, there must be considerable absorption. In nearly every case in which the operation was properly performed, it has been possible to convert a small caliber stricture into one of the large caliber with one electrosection treatment. No patient objected to the treatment and all were satisfied with the results obtained. No definite check was made on postoperative temperatures, though the author is certain that some patients must have had fever reaction.

Total Roentgen Treatment of Endarteritis Obliterans. J. Belot.

Strahlentherap. **56**:560, 1936.

Belot points out that total irradiation is possible only as distant irradiation. To be sure, the two terms should not be confused, since distant irradiations include all those that are given from a distance of more than 50 cm. In total roentgen therapy it requires a distance of about 3.5 meters in order to obtain a uniform irradiation for an adult of average size. The total roentgen therapy is advisable for disorders that involve the entire organism, for instance, diseases of the blood and of the hematopoietic organs, also for dermatoses, such as erythrodermias, certain forms of generalized edema, pruritus, mycosis fungoides and the lymphocytomas of the skin. The hardness of the rays and the filtration that is to be used in each case must be determined on the basis of the depth of the disease process. In diseases of the blood, a hard irradiation is required which, in order to reduce the intensity, is filtered to a high degree of homogeneity. In dermatoses, on the other hand, in which the irradiation of the deeper tissues is to be reduced to a minimum, soft rays are used. The author applied the total roentgen irradiation usually with the roentgen tube high up, the patient lying on a mattress on the floor. After discussing certain details of the technic, he gives his attention to the indications for the total roentgen irradiation. He admits that these are not strictly defined as yet. So far, it is advisable in only a limited number of disorders, but in these it is definitely superior to the irradiation of only parts of the body. — Abst. J. A. M. A. **107**:1767, 1936.

Rodent Ulcer: Its Development on Limbs. H. Newland.

M. J. Australia **2**:221, 1936.

In more than 600 private cases of rodent ulcer, Newland has found five examples of rodent ulcer of the upper extremity. The growths had been present for from ten to thirteen years. The situation of the growth on the limb was on the back of the wrist, the antero-external aspect of the elbow, and the middle of the radial border of the forearm in the men, and the front of the elbow and the middle of the flexor aspect of the forearm in the women. Associated with the rodent ulcers were other growths in every instance but one. All the growths were situated on regions of the upper extremity subject to exposure to the weather, and the skin of all the patients showed evidence of this. Two of the men cited injuries to explain the development of the growth. The author treats early rodent ulcers in the following way unless the growth has attacked the bone, cartilage or conjunctiva: A local anesthetic of procaine hydrochloride is injected around the growth. When the part is anesthetized, the growth is curetted with a stainless steel curet. A rodent ulcer yields to a curet just like granulation tissue, and a smooth surface is left. After a thorough curetting, only a thin layer of the rodent ulcer cells is likely to remain. These are still further reduced by searing the raw surface with an electric cautery. This has the advantage of leaving a dry surface as well as destroying cancer cells. One or two radium 10 mg. plaques are now applied without a filter to the curetted surface and to the edges for an hour. The process is repeated, a thin filter being used. Except in the case of insignificant growth, an erythema dose of x-rays is given as well. With this treatment very few recurrences have occurred and the cosmetic results have been excellent. — Abst. J. A. M. A. **107**: 1762, 1936.